OIL SHALE
TRACT C-B

DETAILED DEVELOPMENT PLAN

DECISION DOCUMENT

BY

TECHNICAL STAFF
AREA OIL SHALE OFFICE
U.S.G.S.
CONSERVATION DIVISION

8/8/77

OIL SHALE TRACT C-B

DECISION DOCUMENT

ON THE

DETAILED DEVELOPMENT PLAN

PREPARED BY

AREA OIL SHALE OFFICE

CONSERVATION DIVISION

GEOLOGICAL SURVEY

U.S. Department of the Interior

****
TRANSMITTAL
****

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Conservation Division
Area Oil Shale Supervisor's Office
Mesa Federal Savings & Loan
131 N. 6th, Suite 300
Grand Junction, Colorado 81501

August 8, 1977

Memorandum

To: Chief, Conservation Division

Through: Conservation Manager, Central Region

From: Area Oil Shale Supervisor

Subject: Approval of Detailed Development Plan for Oil Shale Tract C-b

The Area Oil Shale Office has completed the review of the Tract C-b Detailed Development Plan. The review incorporated input from staff members and all comments from individuals and agencies were considered. This review has been reduced to the attached decision document which evaluates the issues raised.

Based on the issues presented in the decision document, supplementary material to be incorporated into the plan was required of the lessee and a list of 12 Conditions of Approval for the plan were developed.

All required environmental baseline studies have been completed by the lessee and reports have been submitted timely.

The Oil Shale Environmental Advisory Panel has reviewed and commented on the plan. Their comments have been included in the review and are addressed by the supplementary material and Conditions of Approval.

The State of Colorado has provided comments on the plan and their input continues through review of supplementary material. A procedure has been established to maintain consultation and coordination with the State during the permit application process and future operations on the leased lands.

Issues raised during the review process were responded to in three ways. Where direct answers or clarification provided by either the lessee or this office would resolve the question, they were provided, and where appropriate incorporated into the plan through the supplementary material. Where additional detail was required or where programs based on studies to be carried out during early phases of operations were the only feasible means of obtaining answers to questions, they were presented in the supplementary material and made mandatory, both as to substance and timing through Conditions of Approval. Where answers to questions could only be obtained through final detailed design based on findings from initial operations, or from the outcome of the various separate permit stipulations, the submittal of these designs and plans for review and approval was made mandatory by Conditions of Approval. These actions and the issues they apply to are presented in the attached Decision Document.

Major issues addressed during review of the plan and their resolution include the following: Air quality concerns resulted in lessee submission of supplementary emission data and modeling, which indicates that it is feasible to meet all existing air quality standards. Water quantity concerns resulted in submission of supplementary material projecting mine inflow to be between 4000 and 10,000 gpm and water use for the process of 3600 gpm. The major water quality concern was over the effect of spent retorts on ground water. The lessee has submitted data from their private property giving retort water composition and spent retort mineralology. A program to further quantify this issue and to arrive at the best solution has been presented as supplementary material and has been made mandatory during the ancillary phase by a condition of approval. Also included is a program to further quantify the related issue of subsidance. Concerns over revegetation and reclamation were addressed by the submission of a revised Revegetation and Erosion Control Plan, which presents a demonstration program in accord with lease terms. A condition of approval has been included to permit the Government to further revise the environmental monitoring program following review of the final environmental baseline report in accord with lease terms and thereafter as further information becomes available.

Demands for an additional impact statement,either site specific or regional,have been made at every public hearing held under the program irregardless of the plan of operations under debate. The Secretary stated in his decision document that "the Department does not plan to issue any further environmental statements on any phase of the Prototype Program." An additional statement was planned based on results of prototype operations before any further leasing took place. The environmental statement does cover both underground mining - surface retorting and in situ development of Tract C-b. The use of conventional mining methods to create permeability for in situ processing was acknowledged in Volume I of the EIS. In fact, modified in situ is a combination of conventional mining methods presented in the EIS and in situ processing presented in the EIS.

Our review has shown that no new impacts are anticipated from operations under the development plan over those presented in the EIS. The degree of impact is consistent with that presented in the EIS. Since the prototype program was designed to provide answers to issues of environmental, technical and economic feasibility of oil shale development through operations on the leased tracts, an EIS at this time would not provide significant further detail or resolution of these issues.

In view of the fact that an additional EIS at this time would draw primarily on data from the prototype program, which has all been made public and has been subject to public debate through OSEAP and public hearings, and the above discussion on anticipated impacts and technology, we believe that an additional EIS at this time would not provide us or the public with any significant new information, and would serve to delay implementation of the program to find answers.

Based on the results of the review process, I have determined that the tract C-b Detailed Development Plan with the supplementary material and conditions of approval meets the terms and conditions of the Oil Shale Lease and the goals of the prototype program.

I have also determined that the plan is adequate as a management tool for supervision and regulation of operations on the lease tract.

I therefore recommend that the Tract C-b Detailed Development Plan be approved subject to the inclusion of the supplementary material and conditions of approval.

APPROVAL LETTER

WITH

CONDITIONS

United States Department of the Interior

GEOLOGICAL SURVEY
Conservation Division
Area Oil Shale Supervisor's Office
Mesa Federal Savings & Loan
131 N. 6th, Suite 300
Grand Junction, Colorado 81501

Draft

Oil Shale Tract C-b
Lease C-20341

Mr. Bob Loucks
Vice President & General Manager
C-b Shale Oil Venture
P.O. Box 2687
Grand Junction, Colorado 81501

Re: Approval of the Detailed Development Plan for Tract C-b

Dear Mr. Loucks:

The Area Oil Shale Office has completed review of the Detailed Development Plan you have submitted for the development of Tract C-b, which Plan consists of the Detailed Development Plan for C-b dated February 1976, the modification to the Detailed Development Plan for C-b dated February 1977, and the supplemental material you have submitted listed in Appendix A. We have also reviewed other material you have submitted and comments and material submitted by the public and agencies of local, state and Federal governments. I have determined that the Detailed Development Plan for Tract C-b is acceptable and hereby approve the same subject to the terms of the Conditions of Approval set forth in Appendix B.

Upon the execution by you of this letter of approval, you may proceed with the development of Tract C-b pursuant to the approved Detailed Development Plan at such time as the period of suspension of operations for Tract C-b (C-29341) is terminated, and the actions required by the Conditions of Approval prior to commencement of development have been achieved.

Approval of the Detailed Development Plan does not constitute a waiver on the part of the United States of any rights accruing to it under any pertinent statutes or regulations or any of the lease terms, nor does it relieve the lessees from any obligations imposed by such statutes, regulations or lease terms.

This approval of the Detailed Development Plan does not convey any rights to public lands off the lease tracts. Separate permits are required from the Bureau of Land Management for any off-tract facility. Further, approval of the Detailed Development Plan is subject to the lessees obtaining all required permits, at the appropriate time during tract development, copies of which shall be filed with the Area Oil Shale Office. This approval is also subject to the lessee's compliance with all applicable Federal, state and local statutes, regulations, standards and permits.

All development and environmental control work on tract must proceed in accordance with the approved detailed development plan. Should it become necessary to further modify or change the detailed development plan, any such changes must first be approved in writing by the Mining Supervisor pursuant to Section 10(b) of the Lease.

The approved Detailed Development Plan is subject to revision pursuant to Lease Environmental Stipulation 1(c)(1), following review and analysis of the second year's environmental baseline data and final baseline data report by the Mining Supervisor.

Prior to commencing any operations under the approved plan, an additional bond in the amount of $300,000 must be filed with the Bureau of Land Management pursuant to Section 9(b)(1) of the Lease.

Sincerely yours,

Peter A. Rutledge
Area Oil Shale Supervisor

CONDITIONS AND INDEX OF PLANS ACCEPTED:

_____
C-b Shale Oil Venture

_____
Date

ATTACHMENT B

CONDITIONS FOR APPROVAL OF DETAILED DEVELOPMENT PLAN

1. Prior to commencing any operations under the ancillary phase of the Detailed Development Plan (DDP), the lessee shall submit final design plans, as requested by the Mining Supervisor, for his review as to adherence to the DDP, to the terms of the Oil Shale Lease, and to the requirements of 30 CFR Part 231 and 43 CFR Part 23 or any subsequent applicable revisions thereof.

2. Prior to commencing construction of commercial phase facilities, the lessee shall submit plans, as requested by the Mining Supervisor, for his review and approval as to adherence to the plan of action contained in the DDP, to the terms of the Oil Shale Lease and to the requirements of 30 CFR Part 231 and 43 CFR Part 23 or any subsequent applicable revisions thereof.

3. In addition to presentation of environmental monitoring data collected before, during and subsequent to development operations in required annual reports, lessee shall make available to the Mining Supervisor environmental monitoring and other data at such time and in such format as he may reasonably require.

4. In recognition of the available options presented in the DDP, the lessee shall, prior to disposal of any potentially toxic wastes, including but not limited to, sewage sludge, garbage, mineral salts, and other industrial wastes, submit a final plan to the Mining Supervisor for approval. The disposal plan will emphasize reclamation or recycling wherever possible.

5. The lessee shall supplement the raw shale disposal plan and the erosion control and rehabilitation plan of the DDP by submitting a final description of the raw shale disposal sequence, grading and surface contouring to the Mining Supervisor for approval prior to surface disposal. The lessee shall continue to evaluate techniques for underground disposal of mined shale and/or feasibility of surface retorting. Specific details for disposal of solid or liquid wastes with raw shale shall also be included in the disposal scheme submitted.

6. Per lease environmental stipulation 1(c)(1), the environmental monitoring plan of October 1, 1976 shall be revised as needed, based on analysis of the final baseline data report. The revised plan shall be submitted for and approved by the Mining Supervisor prior to commencement of lateral mine development.

7. The lessee will incorporate the best practicable commercially available environmental control technology in all phases of the ancillary and commercial development. Environmental control plans shall be reviewed and revised as needed prior to implementation of the commercial phase development.

8. The plan for dams and impoundments contained in the DDP shall be supplemented by a water management plan that shall be submitted to the Mining Supervisor for approval prior to construction activities. The plan shall include a hydrologic monitoring program during shaft sinking, and a description of surface water handling facilities, dams, impoundments, seepage control, treatment facilities, and groundwater control in the vicinity of the in situ retorts during the ancillary and commercial phases of development. The plan will contain a contingency plan for excess flow. Impoundments and dams for storage of water of poor quality will be constructed and operated to prevent contamination of ground or surface waters. A copy of the required surface flow augmentation plan required under Colorado water laws shall be filed with the Area Oil Shale Office.

9. The lessee shall supplement the raw and retorted shale leaching study, outlined in the DDP, by initiating a program and submitting, prior to commercial phase operations, a report on the mineralogy and leachability of raw and in situ processed shale on Tract C-b. The program will emphasize the solubility and mobility of trace and toxic constituents and the effects of leaching on the load bearing strength of the rubble filled retort chambers.

10. The abandonment plan contained in the DDP shall be supplemented to provide greater detail on retort retirement and stabilization based on the retort leaching study. The supplemented plan shall be submitted to the Mining Supervisor for approval prior to commercial phase retort development. The plan shall emphasize stabilization of in situ retorts, control of leaching from raw and processed shale, and reclamation practices for surface areas used for evaporation of waste waters if any.

11. The lessee shall maintain a program of continuing observation for items of historic, prehistoric, or scientific value during construction and tract operations. The reporting of uncovered objects shall be in compliance with Section 6 of the Oil Shale Lease Environmental Stipulations.

12. The lessee shall submit a detailed evaluation of the actual ancillary retort off gas composition on Tract C-b to the Mining Supervisor. Emission modeling and detailed air quality control plans, including stack locations, for the commercial phase will be submitted by the lessee prior to implementation of the commercial phase development.

ATTACHMENT A

Content of the Approved C-b Detailed Development Plan

For the purpose of approval of the Detailed Development Plan, as Modified, for Tract C-b, the plan consists of the below stated items. The ordering of the below listed items in no way absolves the lessee from logical cross applicability to other portions of the plan.

Items under the Modification column represent changes to the original DDP to modify the plan to development by modified insitu methods. Items under the Supplemental column represent additional detail added to the modification of the plan which were submitted by the lessee as a result of the review process.

(S = Supplemented by)

Section	Original DDP	Modification	Supplemental
1.0 Introduction			
	Due Diligence, I-D-10 (S)	I.A. thru E. Due Diligence, I-E-6	Ancillary Mining Plan, pp. 4-6
2.0 Description of Project Area			
	VII-XIII Oil Shale Resources, I-D-3 Overburden, Fig. II-12	Oil Shale Resources, Fig. I-D Resource Recovery I-E-2	Detailed Baseline Data Reports Qtr's 1-8 First Year Annual Summary & Trends Report
3.0 Overall Development Schedule			
		Schedule, (S) I-E-3(a); III-A and B; III-C-1 and 2; III-E-1; Figure III-4.	Schedule, Ancillary Mining Plan
	Surface-Support Facilities, II-D (S) III-C (S)	Surface-Support Facilities, III-C-3 III-E-4 III-D-2 Figures III-A and B Acreage Disturbed, Table I-B	

Section	Original DDP	Modification	Supplemental
3.0 Overall Development Schedule (continued)			
	Abandonment Plan IV-K (S)	Abandonment Plan, I-E-1 III-E-11 (S)	Abandonment Plan Letter 6/16/77, re., -Retort Stabilization & water Management Letter 6/28/77, re., -Post Operations, -Facility abandonment, -Erosion Control & Rehabilitation
4.0 Mining			
	Surface Facilities, II-D (S)	Surface Facilities, III-C-3	
	Overburden Figure II-12		
	Mine Development, II-F-4 (S) -Shafts, -Ventilation, -Hydrologic Eval., -Dewatering, -Equipment, -Air Quality, -Maintenance, -Waste Disposal	Mine Development, III-C-4(a) (S) I-E-1(a),(b),(c) III-D-1 and 3(a)	Mine Development, -Ancillary Mining Plan Letter, 7/8/77 -Ancillary phase Mining Plan
	Communications II-G-4, IV-C-10		
	Lighting, IV-C-10 (S)	Lighting, III-D-5(c)	
	Shaft Dewatering, II-M-1 (S)	Shaft Dewatering, III-D-5	

Section	Original DDP	Modification	Supplemental
4.0 Mining (continued)			
		Mine Dewatering, III-E-2 (S)	Dewatering, -Letter 4/5/77 -Shaft Dewatering Est. Letter 5/17/77 -Mine Dewatering Rate Letter 5/19/77 -Aquifer Discharge & Quality Letter 6/9/77 -Vertical Permeabilities
	Mine Water Supply, IV-C-10		
		Compressed Air, III-E-6	
			Health & Safety Letter 6/28/77
5.0 Processing (Retorting)			
		Retorting, I-E-1, (S) III-D-3, (S) III-E-2, (S) Figures III-F,G, and J	Retorting, Ancillary Mining Plan Letter 6/28/77 -Retort Operation
	Steam System, IV-I-2 (S)	Steam System, III-E-6 (S)	Steam System, Letter 6/28/77 -Steam Handling
6.0 Overburden & Shale Handling			
		Mined Material, III-D-4 (S) III-E-3 (S)	Material Handling, Letter 6/28/77
	Overburden, V-G and H (S)	V-G and H (S) Table I-B	Raw Shale Disposal Plan -Erosion Control & Rehabilitation Plan

Section	Original DDP	Modification	Supplemental
7.0 Access & Service			
	Roads, II-J (S)	Roads, - - III-D-9 III-E-10	
	Pipelines, III-D-2 and 6 (S) IV-J	Pipelines, - - III-E-5 (S) - - Figure III-L	Pipelines, Letter, 7/8/77 -Marketing Alternatives for Ancillary Phase
	Fuel Supply, II-G-5 (S) IV-C-10	Fuel Supply, - - III-E-6	
		Electric Power, III-D-5 III-E-5 and 6 Figures III-A,B, C & K	
		Water Requirements, III-E-6 (S) - -	Water Needs, Letter 6/28/77 -Erosion Control & Rehabilitation Plan
	Water Supply, I-D-6, (S) III-D-2, IV-C-10	Water Supply, - - I-E-1 (S) - - III-D-5 III-E-2 and 5 IV-D Figures III-G, F and J	Water Supply, Letter 4/5/77 -Shaft Dewatering Letter 5/17/77 -Mine Dewatering Letter 5/19/77 -Aquifer Discharge Letter 6/9/77 -Vertical Permeability
	Dams/Impoundments, II-K (S) III-C-5 (S) Table III-3	Dams/Impoundments, - - III-D-6 - - III-E-7	
	Communications, III-D-4 (S)	Communications, - - III-E-5 and 6	

Section	Original DDP	Modification	Supplemental
8.0 Environmental Protection			
	Environmental Protec. I-D-8 (S)	Environmental Protec. I-E-5	
8.1 Air Pollution Control			
	Control Plan, V-A, Air Quality Control Plan of 11/1/76 (S)	Control Plan, V-A, (S)	Control Plan Plan of 7/21/77 with Appendix A and B Letter, 4/1/77 -Upset Conditions, -Hazardous Substances Letter, 4/15/77 -NOx Emissions Letter, 6/16/77 -Plume Rise
8.2 Water Pollution Control			
		Impoundments, III-D-6 III-E-7	
	Control Plan, III-M-2 IV-E-9 (S)	Control Plan, III-D-6 and & 7 (S)	Control Plan -Field Study of Spent Shale Leaching of 6/17/77.
	V-B (S)	V-B III-D-7 III-E-8	Letter, 6/28/77 -Water Management Plan -Erosion Control & Rehabilitation Plan Letter, 7/1/77 -Lab Leaching Invest.
	Tankage, IV-E-10 (S)	Tankage III-E-4	

Section	Original DDP	Modification	Supplemental
8.3 Spill Contingency Plan			
	Contingency Plan, V-L (S)	Contingency Plan, V-L (S)	Product Oil Handling, -Letter, 6/28/77 -Retort Liquid Handling
8.4 Fire Control			
	Control Plan, V-E (S)	Control Plan, V-E III-E-2 and 6	
8.5 Waste Disposal Plan			
	Disposal Plan, V-I (S)	Disposal Plan, V-I III-D-8 III-E-9	
8.6 Protection of Historic, Scientific, and Aesthetic Values and 8.7			
	Protection Plan V-D (S)	Protection Plan, V-D	
8.8 Noise Control			
	Control Plans, V-C (S)	Control Plan, V-C	
8.9 Fish and Wildlife Management Plan			
	Management Plan, V-J (S)	Management Plan, V-J (S)	Management Plan, -Revised Management Plan of 6/28/77
8.10 Erosion Control and Rehabilitation			
	Control Plan, V-K,G,H (S)	Control Plan, V-K,G,H (S) I-E-5 Table I-B	Control Plan, Letter, 6/28/77 -Revised Erosion Control & Rehabilization Plan Letter of 6/28/77 -Raw Shale Handling

Section	Original DDP	Modification	Supplemental
8.11 Health and Safety			
	Control Plan V-F (S) - - -	Control Plan, V-F (S) - -	Control Plan, Letter, 6/28/77 -Safety & Health Programs
9.0 Environmental Effects			
		Thermal, V-N	
10.0 Monitoring			
	Program I-D-9 VI (S) - - -	Program, VI	Condition,
	Plan of 11/1/76	(Note: Approval conditioned upon submittal of Revised Monitoring Plan upon completion of Final Baseline Date Report)	
11.0 Alternatives			
	II-I (S) - - -	I-E-4 IV-A-D	
12.0 Capitalization			
		I-E-3	
14.0 Socio-Economic			
		I-E-3 (S) - - III-B Figure I-C	Letter 4/18/77 -Manpower, Skill Breakdown

PHOTO COVERAGE OF TRACT C-B

Figure 1: View over Tract C-b to northeast toward Piceance Creek along the ridge between Cottonwood Gulch (left) and Sorghum Gulch (right). Main meteorological tower in foreground. Main aquifer test site in center. Area chained by BLM in late 60's to enhance range productivity. This area will be developed for the commercial gas treatment plant; production, service, and gas shafts; sour water ponds; and transfer point for shale conveyage to depositional sites in the bordering gulches.

Figure 2: View to northeast over main office and laydown facility on Tract C-b toward Piceance Creek. Ridge areas chained in late 60's by BLM to enhance range productivity. Area to the right of the offices will become the site of the commercial service and production shafts.

Figure 3: View to northeast down Sorghum Gulch and its principal unnamed east fork across Tract C-b toward Piceance Creek. This drainage together with Cottonwood Gulch to the west will be the principal raw shale depositional areas.

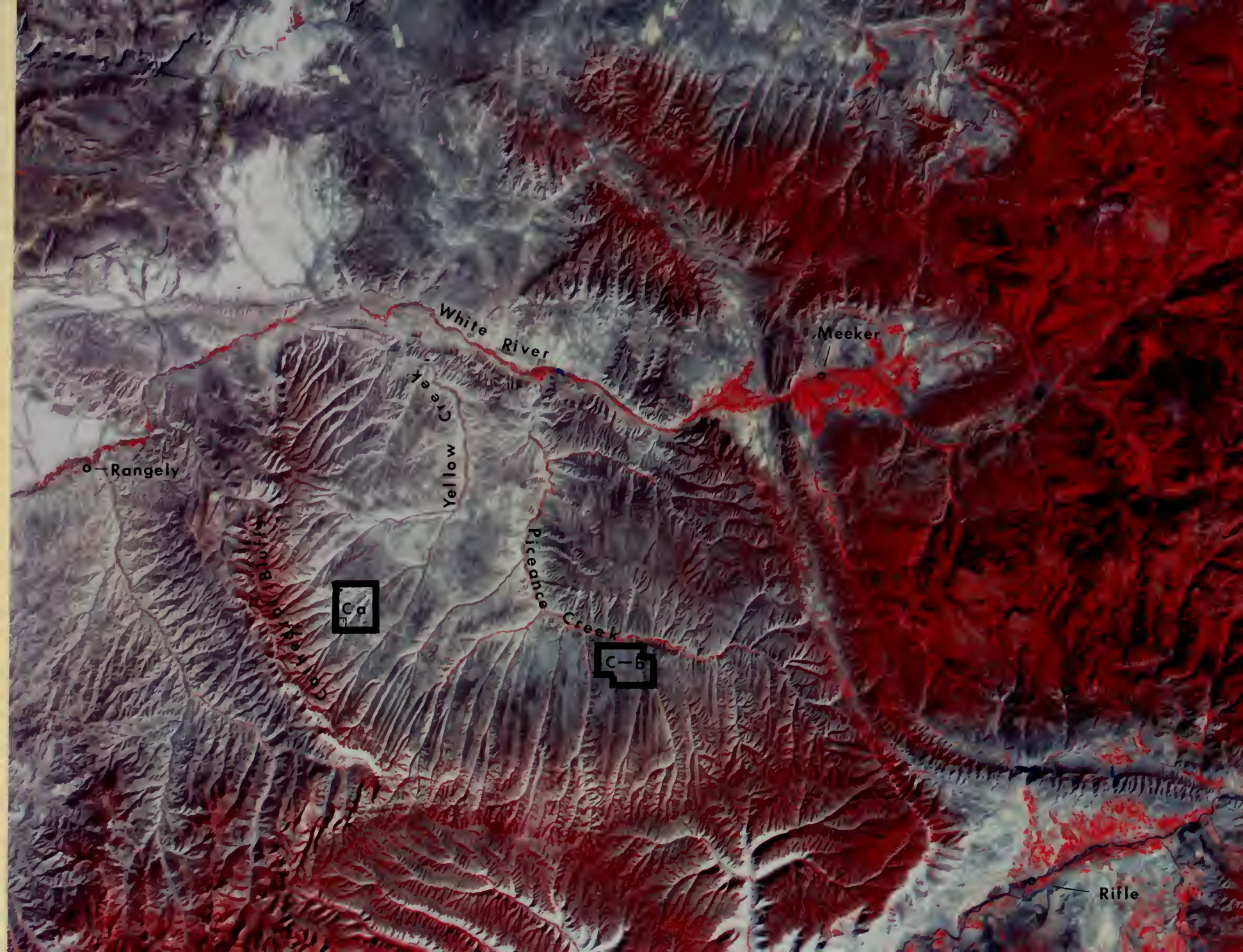
Figure 4: View across Tract C-b toward the northwest. Main meteorological tower near photo center. Office facilities and laydown yard to upper left. Area chained by BLM in late 60's to enhance range productivity. This area will become the site of the commercial gas treatment plant, and retort off gas shaft.

Figure 5: Ground level view toward the northwest across Tract C-b from the ridge between Cottonwood and Sorghum Gulches. Juniper and sage were chained down in late 60's to improve range production. Firewood collectors have sawed off many of the larger trunks.

Figure 6: Ground level view looking west across Tract C-b. Distant drill rig was used to gather geotechnical data on ground water, geologic structure, and oil shale resources along the western edge of the tract.

Figure 7: Pinyon-Juniper stand just north of Tract C-b showing typical lack of understory where P-J is dense. Mule deer use the edges of the pinyon-juniper type for cover, but feed primarily in the open parks and chained areas.

Figure 8: Color infrared photograph of the Piceance Basin and surrounding area. The approximate boundaries of tracts C-a and C-b are shown.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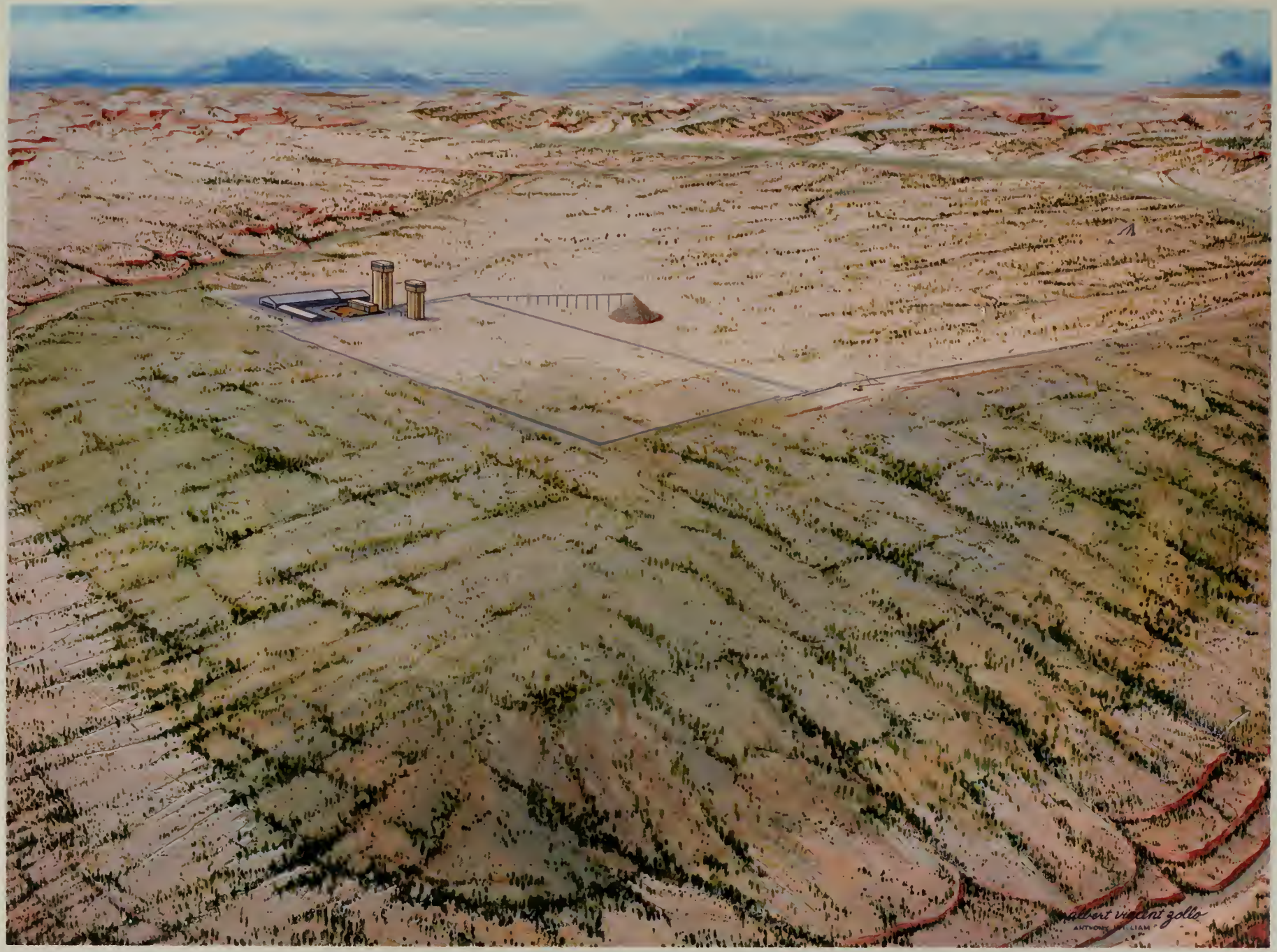
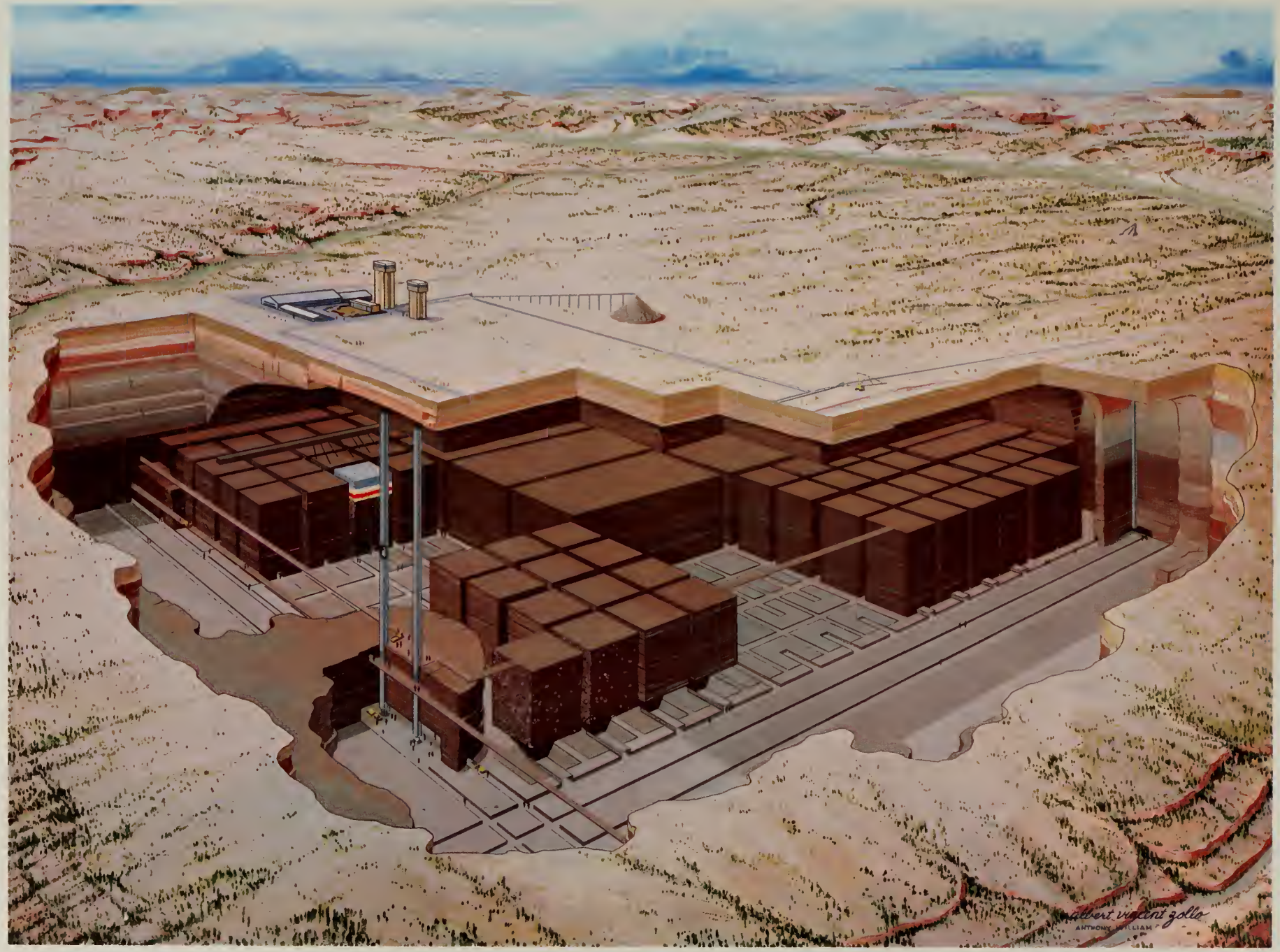


C-b Oil Shale Venture
Occidental Oil Shale, Inc.
Ashland Oil Inc.
Colorado

The Ralph M. Parsons Company
Engineers/Constructors
Pasadena, California



C-b Oil Shale Venture
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Ashland Oil Inc.
Colorado

The Ralph M. Parsons Company
Engineers/Constructors
Pasadena, California

PLAN DOCUMENTATION

THE PROTOTYPE OIL SHALE PROGRAM

The Prototype Oil Shale Program has two goals:

1. Can a commercial oil shale industry be developed in an environmentally sound manner?

2. Can shale oil be produced at a price that is competitive on the open market?

Shale oil production has never been done on a commercial scale, therefore, future impacts can only be estimated. To answer program goals, carefully planned and controlled development is mandated by the Prototype Oil Shale Lease. An environmental monitoring program is required throughout the life of the lease to identify and separate natural environmental changes from development caused changes. "Baseline" monitoring is the two year monitoring period required before construction can begin. "Interim" monitoring is being done during lease suspension. "Production" monitoring will occur after approval of the Detailed Development Plan (DDP). The documents displayed on the following pages present the step by step planning used in developing an environmentally responsive new industry.

The Preliminary Development Plan (3/6/74) presented a conceptual idea of how the lessee proposed to develope the lease tract. The Exploration Plan (5/15/74) detailed the monitoring and exploration work planned by the lessee during the two year "baseline" period.

Detailed data reports submitted every three months on "baseline" environmental monitoring program. Eight and a partial nineth quarter of data was compiled.

Eight summary data reports (outer ring) were widely distributed for public information and comments. First and second annual baseline reports summarize

findings and delineate interrelationships.

Original Detailed Development Plan (DDP) for commercial development (2/76), "Production" Environmental Monitoring Plan (10/76), and Air Quality Control Plan (11/76).

These documents given wide distribution and review by people in the public and private sector.

All comments received on these plans were reviewed, for possible improvement of program.

Volumes document technical review of DDP by AOSO staff.

Socio-economic assessments of impacts on area towns voluntarily done by lessees.

Rapidly advancing technology changed the method of shale oil extraction to modified in situ covered in Modifications to the DDP submitted 2/77.

Modifications given same wide distribtion and review as the original DDP. All comments reviewed for possible improvement of program.

Volumes document technical review of plan modifications by AOSO staff. Matrix was used to tract issues that had to be resolved before plan modifications could be approved.

Volume contains supplemental information and answers provided by lessee to resolve issues identified during review process.

Combined DDP, modifications, and supplemental information indexed and cross referenced. These documents constitute the final plan which will guide development of a

commercial oil shale complex to answer the original prototype program goals.

DECISION DOCUMENT

DECISION DOCUMENT

Detailed Development Plan
Ashland Oil, Inc., Lessee
Occidental Oil Shale Inc., Operator
Oil Shale Tract C-b
Lease C-20341
Rio Blanco County, Colorado

Prepared By

U.S. Geological Survey, Conservation Division
Area Oil Shale Supervisor's Office
131 N. 6th - Suite 300
Grand Junction, Colorado 81501

June 16, 1977

DECISION DOCUMENT

DECISION DOCUMENT

Detailed Development Plan
Ashland Oil, Inc., Lessee
Occidental Oil Shale Inc., Operator
Oil Shale Tract C-b
Lease C-20341

Introduction

This document is the result of an orderly and thorough review of the Modified Detailed Development Plan submitted to the U.S.G.S. Area Oil Shale Office by the lessees of federal oil shale lease tract C-b. The evaluation will address the technical adequacy and compliance with lease terms, including environmental protection. This document represents the ultimate decision on the part of the Mining Supervisor as to the approvability of the detailed development plan, in appreciation of the opinions and technical advice of the staff of the Area Oil Shale Office, the Oil Shale Environmental Advisory Panel, other governmental agencies, industry, special interest groups, and the public. The outline of the Decision Document consists of six parts: (1) Prototype Program; (2) Environmental Impact Statement; (3) Oil Shale Lease; (4) Detailed Development Plan; (5) Issues and Responses; and (6) Recommendation.

Part 1 is a summary of the objectives of the federal prototype oil shale leasing program. Oil shale tract C-b is presented as a part of the scope of the program.

Part 2 summarizes the development of the Final Environmental Statement for the Prototype Oil Shale Leasing Program. Tract C-b is specifically addressed in the environmental statement and this decision document supports the statement.

Part 3 is a detailed discussion of the oil shale lease. The lease and attached environmental stipulations which were developed for the prototype oil shale leasing program and presented in the environmental statement is reviewed. The environmental stipulations are discussed as they apply to specific aspects of the environment.

Part 4 presents the Detailed Development Plan submitted by the lessees of tract C-b and summarizes the issues and comments identified during the review process of the plan. The DDP is summarized in a format that responds to the requirements of the lease and focuses on the development as it relates to specific aspects of the environment. The review process included technical staff review; consultation with the Oil Shale Environmental Advisory Panel; public hearings; and distribution of the DDP to governmental agencies, industry, special interest groups, and the public. Responses to the major issues identified during the review are also presented in this part of the Decision Document.

Part 5 is the recommendation of the approvability of the Detailed Development Plan submitted by the lessees.

This recommendation represents an evaluation of the preceding parts of this Decision Document. Conditions of Approval are incorporated in this part, if the DDP is acceptable.

I. Prototype Program

A. Goal and Objectives

The Prototype Oil Shale Leasing Program was developed in response to a Presidental energy message of June 4, 1971, in which he requested the Secretary of the Interior to initiate "a leasing program to develop our vast oil shale resources, provided that environmental questions can be satisfactorily resolved."

The objectives of the program, stated by the Secretary of the Interior are:

1) to provide a new source of energy that will increase the range of energy options available to the Nation by stimulating the timely development of commercial oil shale technology by private industry;

2) to insure the environmental integrity of the affected areas, and concurrently, define, describe, and develop a full range of environmental safeguards and restoration techniques that can be reasonably incorporated into the planning for a possible mature oil shale industry in the future;

3) to permit an equitable return to all parties in the development of this public resource; and

4) to develop management expertise in the leasing and supervision of oil shale resource development in order to provide the basis for future administrative procedures.

B. Scope

The prototype program was formulated to make available for private development under carefully controlled conditions, a limited number of leases (six) of not more than 5,120 acres each. Such leases would be sold by competitive bonus bidding subject to rental and royalty obligations to the United States. Additional oil shale leasing will not be considered until development under the prototype program has been satisfactorily evaluated in terms of the program objectives.

Federal oil shale tract C-b, for which this document is prepared, is a part of this prototype program. Tract C-b was selected for leasing by the Department of the Interior on April 25, 1972 from twenty individual tract nominations. Two tracts in each state of the oil shale region (Colorado, Utah, and Wyoming) were selected in consultation with the three State governments involved. Tract C-b was subsequently leased on February 12, 1974 (effective date of April 1, 1974) for a bonus bid of $117,788,000. The Wyoming tracts were not leased, since no bids were received.

C. Program Management

In order to comply with the goal and objectives of

the prototype program, the Area Oil Shale Office was established in June of 1974 within the Central Region of the Conservation Division, U.S. Geological Survey to administer the program. The Area Oil Shale Office (AOSO) is greatly assisted by the Oil Shale Environmental Advisory Panel (OSEAP) which was created to advise Department officials on environmental aspects of the prototype program. This Decision Document was prepared by the Area Oil Shale Office in response to its management responsibilities. The Oil Shale Environmental Advisory Panel has reviewed the subject Detailed Development Plan and provided comments for consideration in the Decision Document.

II. Environmental Impact Statement

A. Background

A Final Environmental Impact Statement for the Prototype Oil Shale Leasing Program was prepared by the Department of the Interior, pursuant to Section 102 (2) (c) of the National Environmental Policy Act of 1969, and filed with CEQ on August 30, 1973. The draft of this statement was released to the public on September 7, 1972 and a public review period was held that ended on November 7, 1972. The statement was a study of the environmental impacts of oil shale development and considered the regional impacts of a one million barrel per day industry, specific impacts from development of the six selected lease tracts, and methods of shale oil production including conventional underground and open pit mining with surface retorting and in situ processing of oil shale.

B. Analysis

The Final Environmental Impact Statement consists of six volumes. Volume I provides an assessment of oil shale technology, including in situ processing, and describes the regional environmental impact of oil shale development at a rate of one million barrels per day by 1985. Volume II extends the study with an examination of alternatives to the one million barrel per day level of shale oil production. Volume III examines the specific issuance of not more than

two prototype oil shale leases, including tract C-b, in each of the three states of Colorado, Utah, and Wyoming. Its focus is on the specific environmental impacts of prototype development on public lands which, when combined, could support a production potential of about 250,000 barrels per day.

Volume IV describes the consultation and coordination with others in the preparation of the final statement, including comments received and the Department's responses. Letters received during the review process are reproduced in Volume V and oral testimony is contained in Volume VI. Inspection copies of the final environmental statement are available in the U.S. Department of Interior (Washington, D.C.); Bureau of Land Management State and District Offices in Colorado, Utah, and Wyoming; Area Oil Shale Office; Oil Shale Environmental Advisory Panel office; and at depository libraries located throughout the Nation.

The final environmental statement summarizes that oil shale development would produce both direct and indirect changes in the environment of the oil shale region. Many of the environmental changes would be of local significance, and others would be of an expanding nature and have cumulative impact. These major regional changes would conflict with uses of the other physical resources of the areas involved. Impacts would include those on the land itself, water resources

and air quality, fish and wildlife habitat, grazing and agricultural activities, recreation and aesthetic values, and on the existing social and economic patterns as well as others.

C. Tract C-b

A description of tract C-b, mining and processing options, and the impacts and unavoidable adverse effects of development on tract C-b are presented in Volume III of the Final Environmental Statement for the Prototype Oil Shale Leasing Program. The environmental statement considered two technical options for extraction of shale oil from tract C-b:

1) underground mining and surface processing, and

2) in situ processing by surface well extraction.

Modified in situ development, as proposed in the Detailed Development Plan, can be considered as a refined combination of these two basic technologies.

The use of coventional mining techniques to create the permiability required for in situ shale oil production was acknowledged in the EIS in Volume 4, P. I-36 and P. I-94.

The impacts addressed for development of tract C-b include land requirements, processed shale disposal, surface subsidence, and off-tract land uses. The impacts on particular plant communities or vegetative types is addressed, as well

as; private ranch lands and cultural features; surface and ground water impacts; potential air pollution from particulates, sulfur dioxide, nitrogen oxides, light hydrocarbons, and carbon monoxide; and noise impacts. The destruction of wildlife habitat is presented and includes mule deer, sage grouse, jack rabbits and cottontails, rodents and small animals, and raptors and predatory mammals. Grazing use of the area would be impacted and the recreation and aesthetic values reduced. Meeker, Colorado might be expected to be most severely impacted by development of tract C-b and Rifle, Colorado could become a railroad distribution center.

III. Oil Shale Lease

An oil shale lease was developed for the prototype oil shale leasing program and is presented as part of the proposed action in the final environmental statement. The lease supplements the Department's regulations governing surface exploration, mining and reclamation of lands (43 CFR Part 23) and the operating regulations for mining (30 CFR Part 231).

The format of the lease includes the lease proper and fourteen (14) environmental stipulations which are attached to and specifically incorporated in the lease. These special stipulations were developed for the prototype oil shale program and place additional requirements on the lessee to insure that the environmental impact in the immediate and adjacent area of the development would be minimized. Three lease revisions have been approved based on the experience gained in administering the oil shale tracts under the prototype program. These revisions related to sampling for air quality and meteorological evaluation, studies of flora and fauna, and elimination of typographical errors pertaining to minimum royalty production.

The following discussion summarizes the lease and stipulations as they apply to individual aspects of the environment. The Detailed Development Plan and Modifications have been evaluated with respect to these same aspects of

the environment. Part IV of this Decision Document summarizes the review process, issues identified, their resolution, and recommendations for approval. Oil shale lease C-20341 should be consulted for specific statutory details pertaining to the following discussion. Review areas corresponding to the below described lease terms are indicated in (parenthesis). Required actions completed by the lessee during the two year environmental baseline data gathering period are indicated by (*). Related findings are described in detail in the lessee's six volume Final Environmental Baseline Report, and will be incorporated in detailed engineering plans that will be developed subsequent to Detailed Development Plan approval. These plans will be subject to lease compliance evaluation by the Mining Supervisor prior to implementation pursuant to draft approval conditions contained in Part 5 of this document.

A. Land Surface, Geology, and Soils

Section 2 of the lease grants the lessee the right to prospect for, mine by underground or surface means, and process by retorting or by in situ methods all of the leased deposits. The lessee is also granted the right to construct all works, buildings, plants, structures, roads, powerlines, employee housing, and additional facilities as may be necessary for the mining, processing, and preparation of products for market (4.0, 3.0, 7.0).

The lessee is required by Section 11 of the lease to conduct all operations in accordance with all applicable Federal, State, and local land reclamation statutes, regulations, and standards; and to avoid or minimize damage to the land. Section 12 further requires the lessee to avoid wasting the mineral deposits and surface resources on the leased lands. Operations shall be conducted in such a manner as to avoid or minimize damage to improvements on the leased lands (8.0-8.11).

Section 13 of the lease states that any entry, well, or opening for in situ operations shall not be within 500 feet of the lease boundary and induced fracturing shall not extend to less than 100 feet from the boundary (3.0, 4.0, 5.0).

The lessee is required by Section 1(C)2 of the environmental stipulations to collect data and conduct a monitoring program for soils and their productivity (*).

Section 11 of the stipulations requires an erosion-control and surface-rehabilitation plan as part of the development plan. The lessee is required, in accordance with such an approved plan, to rehabilitate all affected lands to a usable and productive condition consistent with or equal to pre-existing land uses in the area and compatible with adjacent undisturbed areas. Areas susceptible to slides and slips, excessive settlement, severe erosion, and

soil creep must be avoided where possible. Waste rock from the mining operations must be utilized for roadbeds, fills, and other construction purposes when possible. Additional gravel and other construction materials will be purchased in accordance with 43 CFR 3610 (Mineral material sales). All cut and fill slopes will be maintained in a stable condition (8.10).

Section 14 of the environmental stipulations requires the reclamation and compaction of excavated material and processed shale to minimize erosion. The slope faces of waste piles will be designed to insure slope stability and will be revegetated in accordance with the plan. All waste will be disposed of in accordance with applicable standards and guidelines of the State, U.S. Public Health Service, and the Environmental Protection Agency. The disposal system must be designed and constructed to avoid landslides, control erosion, and establish conditions conducive to vegetative growth. No disposal of waste can create an impoundment of water unless specific plans are approved by the Mining Supervisor. Impoundments will be required for slurry waste disposal systems (8.10).

B. Water Resources

The lessee is required by Section 11 of the lease to conduct operations in accordance with all applicable Federal, State, and local water pollution control and water

quality statutes, regulations, and standards; and avoid or minimize damage to the water resources. Section 12 provides that water rights developed through operations will become the property of the lessor, but the lessee shall have the right to use those waters for activities under the lease (8.2).

The lessee is required by Section 1(C)2 of the environmental stipulations to collect data and conduct a monitoring program for surface and ground water. Springs and seeps shall be monitored (*, 10.0).

Section 9 of the stipulations requires the lessee to conduct operations in accordance with all applicable Federal and State water-quality standards. The Mining Supervisor must approve all disturbances of existing waters. Surface water and ground water will be diverted from operations so as to avoid the formation of toxic and saline water and its drainage into streams. Refuse and spent shale will be disposed of in a manner which will avoid the discharge of toxic drainage of saline water. Spoil and refuse will be monitored for the presence of materials likely to yield alkaline, acidic, saline, or toxic solutes. No water will be reinjected, except in compliance with Federal and State standards and as authorized by the Mining Supervisor (8.2, 10.0).

This stipulation also states that cuts and fills will not result in siltation of streams. All stream crossings must be approved by the Mining Supervisor. Buffer strips at least 200 feet (61 m) wide must be maintained in their natural state on each side of a stream. The Mining Supervisor must approve all road surfacing materials (7.0).

Section 11 requires that safe access will be provided to permanent water impoundments for persons, livestock, and wildlife. Access must be prevented to such water sources if they are of harmful quality. Improvements or operations must not be conducted in flood plains without the express permission of the Mining Supervisor and without providing for protection of any such improvements. Section 1(F) requires that impoundments be constructed to withstand a 100-year flood (8.2).

C. Vegetation

The lessee is required by Section 12(C) of the lease to avoid or minimize and repair damage to forage and timber growth, and crops (8.10).

Section 1(C)2 of the environmental stipulations requires the lessee to conduct a data collection and monitoring program of the flora on the leased lands and within a mile of the lease (*, 10.0).

Section 11 of the stipulations requires the lessee to rehabilitate all affected lands according to an erosion-

control and surface-rehabilitation plan approved by the Mining Supervisor. Revegetation must be initiated not later than 1 year after completion of a particular operation. Topsoil must be saved and used for rehabilitation. Permanent vegetation must be restored to disturbed areas. The Mining Supervisor may require the lessee to fence areas to assist revegetation (8.10).

The lessee must initiate a revegetation program at the start of production and must demonstrate at the time he submits the detailed development plan that revegetation technology can meet these stipulations. If the required technology cannot be demonstrated, a program must be initiated to obtain the required technology. If the lessee has not demonstrated the necessary revegetation technology by the tenth anniversary date of the approved development plan, the lessee must cease all development and production operations until he has demonstrated that the technology is available (8.10).

The clearing and use of timber and other vegetative material is restricted by section 13 of the stipulations. No cutting or removal is permitted outside marked clearing boundaries. All trees cut will be felled into the right-of-way and away from live water courses. Clearing and grubbing limits will be approximately 5 feet (1.5 m) outside the edge of any cut or fill. Trees, snags, stumps, or other woody

material not having wildlife value or value to the lessee will be mechanically chipped and spread to encourage revegetation and to stabilize soil. Clearing boundaries will be identified on the ground prior to clearing operations. Roadbeds will be cleared no more than 25 feet (7.6 m) from the centerline unless otherwise specified by the Mining Supervisor (7.0, 8.10).

D. Wildlife

The lessee is required by Section 1(C)2 of the environmental stipulations to conduct a data collection and monitoring program of the fauna on the leased lands and within a mile of the lease. Aquatic habitat shall be monitored as far downstream as the Mining Supervisor shall require (*, 8.9).

A detailed fish and wildlife management plan is required as part of the detailed development plan under section 4 of the environmental stipulations. The plan must include steps to minimize damage to habitat, restore damaged habitat, provide alternate habitats, and provide controlled access. Wherever destruction or significant disturbance of fish and wildlife habitat is unforeseen in the detailed development plan, the lessee must submit, for the Mining Supervisor's approval at least 60 days before the destruction or damage of habitat, those measures that the lessee proposes to take in order to mitigate the damage. Big game drift

fences shall be constructed, when and where necessary, to direct big game movements around development areas. The lessee must post notices informing employees of all applicable laws and regulations governing hunting, fishing, and trapping (8.9).

Section 11 requires the lessee to restore the vegetation of disturbed areas by reestablishing permanent vegetation of a quality that will support fauna of the same kinds and in the same numbers as those existing at the time the baseline data was collected (8.10).

The lessee is required by section 2(I) of the stipulations to design and construct all electric transmission lines for raptor protection in accordance with REA Bulletin 61-10 (7.0).

E. Agriculture and Range

Section 12(c) of the lease requires the lessee to avoid or minimize and repair damage to crops and improvements on the leased lands (7.0).

Sections 2(J) and (K) of the stipulations require the lessee to construct fences and cattleguards according to BLM specifications and standards (7.0).

Section 3 requires the lessee to make every reasonable effort to prevent, control, and suppress any fire on the leased lands. The lessee must also comply with the National Fire Codes on handling, transportation, storage, use, and

disposal of flammable liquids, gases, and solids. The control and suppression of any fires caused by the lessee will be at the expense of the lessee (8.4).

Pesticides and herbicides cannot be used without the approval of the Mining Supervisor and in accordance with applicable Federal and State procedures under section 7 of the environmental stipulations (8.2).

The lessee will establish safe access to permanent water impoundments for livestock and wildlife under section 11 (H) (8.11).

F. Air Quality and Meteorology

The lessee is required by Section 11 of the lease to conduct operations in accordance with all applicable Federal, State, and local air pollution control and air quality statutes, regulations, and standards; and avoid or minimize damage to the air resources (8.1).

Section 1(C)2 of the environmental stipulations requires an air quality data collection and monitoring program (*, 10.0).

Section 8 of the stipulations requires the lessee to comply with all air-quality standards adopted pursuant to the Clean Air Act and operate all facilities to avoid or minimize air pollution. Every reasonable effort must be made to avoid or minimize dust problems. Where necessary,

sprinkling, oiling, or other means of dust control will be required on roads and trails. Burning of waste, timber, or debris must be authorized by the Mining Supervisor (8.1).

G. Transportation and Utilities Systems

The lessee is granted the right under Section 2 of the lease to construct on the leased lands all roads, powerlines, and additional facilities necessary for the mining, processing, and preparation of products for market (7.0).

Section 2 of the stipulations requires the lessee to provide corridor plans for roads, pipelines, and utilities. Multi-use corridors must be used to the maximum extent practicable. Existing roads and trails must be used where feasible, as determined by the Mining Supervisor. Roads will be located, built, maintained, and closed to BLM specifications. After roads are constructed, the lessee is required to permit free and unrestricted public access, except in hazardous operational areas. If use of existing roads and trails is restricted, the lessee is required to provide alternate routes as needed. Off-road vehicle use must be consistent with applicable regulations (7.0, 7.1, 7.2).

The design and construction of oil pipelines will follow standards established by the Department of Transportation, and the lessee will meet the safety standards in 49 CFR 110, 49 CFR 192, and 49 CFR 195 of the Department of Transportation.

The lessee must also provide for automatic shutoff valves. Detailed pipeline corrosion plans must be submitted to the Mining Supervisor (7.1).

Section 2 additionally requires the lessee to design and construct telephone and electric transmission facilities in accordance with the Department of Interior and Department of Agriculture guidelines set forth in "Environmental Criteria for Electric Transmission Systems" (7.2).

A spill contingency plan, required by section 7 of the stipulations, must be submitted to the Mining Supervisor as part of the detailed development plan. The plan must conform to the Federal Water Pollution Control Act and the National Oil and Hazardous Substances Pollution Contingency Plan. The lessee must give immediate notice of any spills of oil or hazardous substances, and he must control, clean up, remove, and dispose of any spills. Oil, petroleum products, industrial chemicals, and similar toxic or volatile materials must be stored in durable containers and located so that accidental spillage will not drain into water courses, lakes, reservoirs, or ground water. The storage areas must be surrounded by impermeable containment structures (8.2, 8.3).

H. Recreation

Section 2(B) of the stipulations requires the lessee to permit reasonable, free, and unrestricted public access upon roads for all lawful and proper purposes. Off-

road vehicle use under section 2(N) must be consistent with applicable regulations. Section 4(B) requires the lessee to submit a habitat management plan which includes access to the public for wildlife hunting and viewing opportunities. The lessee will establish safe access for the public to permanent water impoundments under section 11 (H) of the stipulations. Sections 12 and 15 also pertain indirectly to recreation (7.0, 8.11).

I. Cultural Resources

Before construction or mining, the lessee is required by Section 6 of the stipulations to conduct a thorough and professional investigation of the leased lands for objects of cultural antiquity, historic, prehistoric, or scientific interest. Such objects must not be removed, injured, defaced, or altered by the lessee. The lessee must report the results of these investigations to the Mining Supervisor before commencing construction and mining operations. The lessee shall not remove or destroy any cultural resources discovered during activities on the lease (8.6).

J. Esthetics

Section 12 of the environmental stipulations establishes scenic standards in all designing, clearing, earthmoving, and construction. Contours will be compatible with the natural environment. Natural colors consistent with the local environment will be used in the painting of

facilities. Natural openings will be used in construction, and contouring of disturbed areas will simulate natural openings. Esthetic values must be considered in all planning, construction, reclamation, and mining. The design of structures and facilities will blend with the natural landscape. Signs will be rustic in appearance and conform to BLM sign standards. Sections 8, 11, and 14 also pertain indirectly to esthetics (8.6 which includes 8.7).

K. Health and Safety

Section 12(a) of the lease requires the lessee to conduct all operations on the leased lands so as to prevent injury to life, health, or property. The lessee must also avoid or minimize, and correct hazards to the public health and safety related to his operations on the lease (8.11).

All buildings and structures, under Section 1 (F) of the stipulations, shall comply with the Uniform Building Code. Compliance with the Federal Metal and Non-metallic Mine Safety Act of 1966 and the Occupation Health and Safety Act of 1970 is required by Section 5 of the stipulations. All blasting operations must conform with Public Law 91-452 and the appropriate regulations in 26 CFR 181. The lessee is required to comply with all applicable Federal, State, and local standards on noise pollution. Noise will be kept at or below levels safe and acceptable for humans (8.8, 8.11).

L. Socio-Economics

Measures and stipulations to mitigate social and economic impacts from oil shale development are not addressed in the lease or attached environmental stipulations. But the lessees have recognized these potential impacts and are pledged to support and cooperate with regional planning. These efforts are more fully described in part IV of this Decision Document.

Section 2 of the lease does provide for employee housing and Section 18 addresses employment practices. The Equal Opportunity clause in this lease is presented as Section 19.

M. Off-Tract

An oil shale lessee or any other party will have to make separate applications for rights-of-way for roads, power transmission lines, telephone lines, and pipelines and for special land use permits and other rights to use land outside the tract for purposes directly or indirectly connected with oil shale development. The environmental stipulations which will be included in such leases, permits, licenses, or other instruments may vary somewhat with the type of permit issued. These stipulations will typically specify seeding mixtures, vegetative clearing methods, erosion control, construction methods, range improvement and wildlife protection, rehabilitation specifications, require archaeological surveys, and painting of structures to minimize visual impacts.

N. Lease Administration

Several sections of the lease and attached environmental stipulations address lease administration requirements and not environmental issues. These requirements, as they specifically pertain to the Detailed Development Plan, are summarized in this section.

The payment of bonus bid installments is discussed in Section 5 of the lease. The lessee may credit against the fourth and fifth bonus installments any expenditures directly attributable to operations on the lease for the development of the leased deposits. Expenditures for preparation of the detailed development plan are not attributable to such credit.

Section 7 of the lease requires a royalty on all oil shale extracted by the lessee which is either processed or sold. Royalty for oil shale extracted by mining methods shall be determined on the monthly average of shale oil content of the oil shale, determined by the modified fischer assay method. The royalty for oil shale processed by in situ methods shall be determined by the total gross heat of combustion in BTUs of all oil and gas products, adjusted downward by the total gross heat of combustion of combustible fluids injected as heat carriers. The lessee shall determine accurately the weight or quantity, and quality of all oil shale produced by each method.

The payment of minimum royalties is required under Section 7(e) of the lease. Beginning in the sixth lease year the royalty payments for tract C-b will be based on a minimum annual production rate of 616,000 tons of 30 gpt oil shale. The minimum annual production rate will increase by 616,000 tons of oil shale per year through the 15th lease year and then remain at an annual rate of 6,160,000 tons of oil shale through the 20th year, at which time the lease terms may be readjusted.

Upon approval of a detailed development plan, the lessee is required by section 9 of the lease to file an additional bond which shall be conditioned upon the faithful compliance with 30 CFR 231, 43 CFR 23, and the lease and environmental stipulations. The bond shall not be less than $20,000; but represent $2,000 per acre of spent shale disposal sites and mining operations, and $500 per acre for all other portions of the leased lands affected.

Section 10 of the lease requires the lessee to submit a Detailed Development Plan on or before the third anniversary date of the lease. The lessee is required to use all due diligence in the orderly development of the lease and attain production at a rate at least equal to the minimum production rate under Section 7(e) of the lease. The lessee shall obtain the Mining Supervisor's approval of the development plan prior to commencing operations. The

Mining Supervisor shall hold public hearings and consider both technical and environmental provisions of the plan prior to approval.

Sections 31 and 32 of the lease address the disposition of surface and underground facilities upon the termination of the lease. Abandonment is also conditioned upon the compliance with the reclamation requirements of the approved development plan.

Section 1(C) of the environmental stipulations requires the lessee to collect baseline data for at least one full year prior to the submission of the Detailed Development Plan. The environmental monitoring program shall be an integral part of the detailed development plan and a complete compilation of the baseline data collected shall be provided to the Mining Supervisor at the time of the submission of the plan.

IV. Detailed Development Plan Review

A. Detailed Development Plan

Tract C-b lease C-20341 was acquired effective April 1, 1974 by Ashland Oil, Inc., Atlantic Richfield Company, Shell Oil Company, and The Oil Shale Corporation (TOSCO) for a competitive bonus bid of $117,788,000.36 payable in five annual installments. Atlantic Richfield and TOSCO withdrew from the C-b Shale Oil Project in late 1975 and Shell Oil followed in late 1976. The remaining lessee,

Ashland Oil, announced a partnership with Occidental Oil Shale Inc., in late 1976.

Exploration and environmental baseline data plans were received from the lessees of tract C-b in May of 1974. These plans were revised and approved with conditions, and baseline data collection commenced by the fall of 1974. Two years worth of data was collected by the end of 1976 and the lessee has submitted nine Quarterly Detailed Data Reports, eight Summary Reports, an Annual Summary and Trends Report, a Final Environmental Baseline Report, and a two volume Socio-economic Report to the Area Oil Shale Supervisor. For a detailed description of the existing environment of the tract C-b area prior to oil shale development, the environmental baseline data is referenced (Appendix B).

The lessees submitted the required Detailed Development Plan for tract C-b in February, 1976. The proposed plan was to develop the tract by an underground room and pillar mine with surface retorting of oil shale and processed shale disposal on the surface. This plan was reviewed by the Mining Supervisor and after certain deficiencies were made up by the lessee the plan was determined to be incompliance with the lease.

On March 4, 1976 the lessees of tract C-b applied for a suspension of operations pursuant to Section 39 of the Mineral Leasing Act and Section 22 of the Oil Shale Lease.

A suspension of operations was granted effective September 1, 1976, by the Area Oil Shale Supervisor for the following reasons:

1) Data from the first year environmental baseline air quality program showed that natural background amounts of non-methane hydrocarbons, ozone, and particulates on occasion exceeded National Ambient Air Quality Standards (NAAQS). This could prevent development of the tract. The Environmental Protection Agency was consulted on this issue prior to granting the suspension and has worked to resolve the issue by administrative interpretive procedures during the period of suspension.

2) The on-tract drilling and rock mechanics program revealed that rock strength was considerably less than that assumed from mines on the basin margins, thereby decreasing resource recovery by room and pillar mining methods to an unacceptable degree.

On March 1, 1977 the tract C-b lessees submitted "Modifications to the Detailed Development Plan," revising the method of shale oil production, from room and pillar mining with surface retorting, to modified in situ methods. This Decision Document addresses the modified development plan.

B. Review Process

The review of a Detailed Development Plan involves a 6-9 month process of submittals, evaluation, meetings, and public hearings which lead to the final decision on approvability of the plan by the Area Oil Shale Mining Supervisor. The procedure includes distribution of the DDP to concerned governmental agencies, industry, special interest groups, and the public; consultation with the Oil Shale Environmental Advisory Panel; public hearings; and technical staff review. The findings, needs, and resolution of issues identified by this process are contained in this final Decision Document.

The technical staff review of the plan and comments from other groups by the Area Oil Shale Office is recorded in an Evaluation Document (ED) which is an internal working document that provides the basis for this formal Decision Document. The process for completing the ED assures that the technical staff completes an orderly and thorough review of the Detailed Development Plan in appreciation of the various guidelines, conditions, lease stipulations, and other regulatory requirements that impinge on oil shale development on Federal lands. The document is appreciative of the opinions and technical advice of the Oil Shale Environmental Advisory Panel, other governmental agencies, industry, special interest groups, and the public. The ED consists of three parts: (1) composite outline of the Detailed Development

Plan by subject areas; (2) subject reference analysis; and (3) subject compliance and impact evaluation. The final working ED document consists of several loose leaf binders organized by subject areas and a matrix analysis of issues.

Over 200 copies of the original Detailed Development Plan for tract C-b, submitted by the lessees to the Area Oil Shale Office on February 9, 1976, were distributed for review on February 13, 1976. An Oil Shale Environmental Advisory Panel (OSEAP) meeting was held in Grand Junction, Colorado on April 8, 1976, to discuss the Detailed Development Plan and provide advice to the Area Oil Shale Supervisor. Public hearings were held in Meeker, Colorado and Denver, Colorado, on April 20, 1976, and April 22, 1976, respectively. Final OSEAP advice was submitted to the Area Oil Shale Supervisor by letter on May 24, 1976. The Area Oil Shale Office completed staff review and notified the lessee on November 22, 1976 that the plan, with additions developed during the review process, met the terms and conditions of the oil shale lease. However, its implementation required the resolution of issues which resulted in the 1 year suspension of operations.

The Modified Detailed Development Plan was submitted to the Area Oil Shale Office on March 1, 1977, in hopes of resolving the technical problems which were of concern to the lessee in early 1976. Over 200 copies of the Modified

DDP were distributed for review on March 2, 1977. An Oil Shale Environmental Advisory Panel (OSEAP) meeting was held in Denver, Colorado on April 6, 1977 to discuss the Modified DDP and to provide advice to the Area Oil Shale Supervisor. A public hearing was held in Meeker, Colorado on April 19, 1977, and a courtesy hearing was held in Denver, Colorado on May 3, 1977. Final OSEAP advice was submitted to the Area Oil Shale Supervisor by letter on May 20, 1977. The technical staff of Area Oil Shale Office has completed its review of the Modified DDP by preparing this Decision Document.

C. Plan Review

The following discussion summarizes the basic development plan contained in the Modified Detailed Development Plan, presents the major issues identified during the review processing with respect to technical and environmental aspects and the manner in which these issues have or will be resolved. The format used is similar to that compiled in the Subject Compliance and Impact Analysis section of the ED which served as the basis for requesting supplementary data from the lessee and/or formulation of draft conditions for approval contained in Part V of this document. The Modifications to the Detailed Development Plan and supplemental material submitted by the lessees of tract C-b should be consulted for specific details (Appendix).

Part 1.0, Introduction

a. Basic Plan

The lessee intends to modify the original, approvable, plan of development from large scale underground mining and surface retorting to modified in situ methods. Oil Shale will be rubblized and retorted underground. This objective will be achieved by a two phased program: 1) construction and ancillary testing (September 1977 - mid 1982); and 2) full scale commercial production (1982 - 2040) at 57,000 bbl/day. During construction, 4 permanent, 1700 foot deep shafts, (1, 15 foot diameter and 3, 34 foot diameter) for production, ventilation, escape, service, and retort off gas; and one temporary 10 foot diameter retort exhaust gas shaft will be sunk in the western portion of the tract. Lateral mine workings will be driven from and between these shafts above, below, and within the 310 foot high retort zone which begins just above the Mahogany marker and extends near the bottom of the R-6 Zone. At the same time, temporary retort off gas and shale oil handling facilities, tract access roads, steam generation facilities, and a filled area for commercial plant construction at the head of Cottonwood Gulch will be built.

During ancillary testing, two or more commercial size retort chambers (200 ft x 200 ft x 310 ft high) and a cluster of four retorts will be prepared and operated (see

Parts 4.0 and 5.0). If these can be operated successfully, the lessee will proceed to scale up mining, retort preparation, and surface facilities to achieve commercial production of 57,000 bbl/day. Retorts will be developed in clusters of 8 or more and will feed surface facilities located at the head of Cottonwood Gulch. Permanent dams and impoundments will be constructed in the lower reaches of Cottonwood and Sorghum Gulches together with seepage tight ponds for sour water and water treatment concentrates.

Commercial operation will develop 1.2 billion barrels of the 3 billion barrel resource across the height of the retort zone (40% of the resource) in a manner that will not preclude future development of underlying oil shale resources.

Construction and operation will require a peak work force of 1,180 during ancillary development and 2,900 during scale up to commercial operations with a permanent personnel level of 1,600.

Total required capital investment is now estimated at $442,609,000.

Disturbance of surface areas on tract would arise principally from construction of permanent facilities and disposal of mined shale, and is estimated to reach 100 acres per year for the first 10 years, dropping thereafter to about 1/3 that amount.

Alternatives that will be investigated include surface retorting of mined shale that could add an additional 450 million barrels to tract production, and on site electric power generation from low BTU retort off gas.

Plans for environmental protection are discussed in Part 8.0. After the estimated 65 years of current tract life, the tract will either be abandoned in full compliance with lease stipulations or operated on resources in lower oil shale horizons.

b. Issue/Needs

(i) Socio-economic impacts of changed manpower levels, tenure or residency, skills, and location of settlement.

(ii) Feasibility of disposing of mined raw shale underground.

(iii) Completeness of material flow balances.

(iv) Lack of operating cost data.

(v) Lack of sufficient information required to obtain State or Federal permits.

(vi) The DDP should contain an EIS.

c. Resolution of Issues

(i) The lessee, by letter of April 18, 1977, provided a detailed manpower skill breakdown for the 1600 permanent employees. It is not, however, within the jurisdiction of the

Mining Supervisor to respond directly to socio-economic issues, except as pertains to employment practices. The lessee, however, has prepared a two volume socio-economic assessment report, and have initiated and actively participate in community impact mitigation task force groups in Meeker and Rifle to aid in timely community planning to accommodate anticipated population growth. The lessee has also revised population growth rate estimates for Rifle.

(ii) The lessee has indicated his willingness to evaluate the feasibility of underground emplacement of mined shale. The lessee will also be required by specific condition of approval (see condition below) to continue evaluation of the feasibility for underground disposal of mined shale.

(iii) Figures III-F, G in the DDP Modifications are specific material flow balance diagrams. Additional estimated flow balances are presented in "confidential" submissions on file at the Area Oil Shale Office. The referenced figures will be updated as engineering design progresses.

(iv) Estimated operating cost data is on file at the Area Oil Shale Office as confidential submissions by the lessee.

(v) Approval of the DDP is specifically predicated on the lessee obtaining all applicable permits at times appropriate to development, as well as compliance with all applicable Federal, State and local statutes. It is obligatory on the lessee to prove to the permitting agency that they can, in fact, comply with statutory standards. Thus, it is not incumbent upon the Mining Supervisor to conclusively prejudge such compliance as long as there is reasonable grounds to believe that the lessee can in fact meet regulatory standards. The DDP was never intended to suffice as data requisite for permit applications. The lessee is thoroughly appreciative of this fact. The lessee will be required, by the approval letter, to file all permit applications and permits obtained with the Mining Supervisor.

(vi) The DDP was not intended to be an EIS. It is intended to spell out the most probable path of tract development and the environmental

controls that will be instituted to meet lease and statutory standards. With the conditions of approval spelled out for this part and following sections, this objective, consistent with the continuing NEPA process will be met.

d. Recommendations

That all introductory parts of the plan, as listed below, be approved subject to the following condition of approval:

Original DDP: I-D-10

Modifications: I-A through I-E

Supplemental: Ancillary Mining Plan, pp. 4-6.

e. Conditions

The lessee shall continue to evaluate the feasibility of surface retorting of mined shale and the underground disposal of mined or surface retorted shale.

2. Part 2.0, Description of Project Area

a. Basic Plan

Description of the project area is presented at length in Volume II, Sections VII through XIII of the original DDP (February 1976); the First Annual Summary and Trends Report based on one complete year of environmental baseline data; two complete years of environmental baseline data on public file at the Area Oil Shale Office; and in the Final Environmental Baseline Report now being received as volumes become available from the printer.

The tract is situated in the southeastern portion of Piceance Creek Basin as part of the high, arid Roan Plateau. The Tract is topographically dominated by northeast-trending linear valleys and ridges averaging 6,800 feet in elevation. Their development appears to be structurally controlled by subparallel trending joints and fractures along the gently, northward dipping flank of the Hunter Creek syncline.

Oil Shale, of principal economic interest, commences with the Mahogany Zone which is situated under 1,200 feet of massive sandstone, siltstone, and low grade marlstone overburden and extends downward for several hundred feet. This horizon is underlaid by an additional 800 feet of alternating rich and lean shale that may have future economic potential if mineability problems are resolved. Nahcolite and dawsonite

associated with the lower zone shales appear to be too lean in the tract area to ever be of commercial interest.

C-b tract is drained by several intermittent northward flowing drainages into Piceance Creek, which has an average annual flow of 14,500 acre feet and a TDS at its confluence with the White River of 2,000 mg/l. Approximately 80% of base flow is groundwater discharge. The groundwater regime can be thought of as two principal fractured bedrock aquifer systems generally separated by the low vertical permeability of the rich Mahogany Zone shales. The lower aquifer is slightly more saline than the upper. Productivity of both is low (120-350 gpm) with horizontal permeabilities of 0 to 300 millidarcies and very restricted vertical communication principally along fractures that tend to plastically heal across rich shale horizons.

Air quality has been called pristine. On occasion, however, natural particulate levels and concentration of non-methane hydrocarbons rise above statutory limits. Temperatures on tract range from highs approaching 100°F to lows of nearly -30°F. Relative humidity ranges from 8 to 100% with diurnal variations of 80%. Winds on tract blow principally from the south and southwest at 3 to 10 mph, although gusts of nearly 80 mph have been recorded. Intense, but short-lived, inversions have been noted, particularly during winter months. Precipitation averages 12 inches annually with most falling during the winter as snow.

The tract is dominated by a pinyon-juniper, desert shrub vegetative community. Approximately 45% of the tract area has been clear chained by BLM to enhance range and productivity. Such a vegetative regime supports a widely varying small and medium sized mammal population dominated by the larger mule deer, predatory birds, and carnivores such as coyote. No rare or endangered species have been identified on tract.

Aquatic habitat is quite limited and confined to Piceance Creek north of the tract and small spring fed ponds along Willow and Stewart Creeks. Most abundant fishes are of the nongame type with no endangered species identified.

Soils on tract are light to medium textured (sandy, silty, clay loams), varying from only a few inches in depth over ridge areas to several tens of feet in valley bottom areas. As a whole, they are moderately productive with vegetative support characteristics limited mostly by available moisture, slope and aspect.

Aesthetically, the tract is moderately scenic. It is visually blind to major transportation routes in the area. Relatively major modification could be made to tract topography without seriously altering its visual quality or utility.

Culturally, the tract area received only incidental hunting use by early Ute or pre-Ute tribes. Only two historically

sensitive areas have been identified on tract. These have been judged of marginal value worthy of further study only if they would be disturbed by development activities. Their location generally precludes this possibility. Archeological reports and recommendations that have been reviewed and concurred in by the Advisory Council on Historic Preservation, indicate no sites eligible for inclusion in the National Register. Required 106 statements have been filed.

b. Issue/Needs

(i) Feasibility of future development of oil shale resources and conventional oil and gas reserves from strata underlying the retort horizon.

(ii) Economic potential of nahcolite and dawsonite within the retort horizon.

(iii) On-tract availability of soil and soil-like material for reclamation.

c. Resolution of Issue

(i) Evaluation of the DDP suggests that development of deep oil shale horizons or conventional oil and gas reserves, if any, will not be precluded by the planned in situ development. Future development of oil shale underlying the currently defined horizon can utilize shafts that will be developed for the planned

operation. Practical solutions to increased groundwater inflow and developing retort rubble columns under confining pressures at 1500 or more feet would first have to be resolved. Oil and gas exploratory wells could be drilled through the shaft pillars that will be greater than 1,000 feet in diameter, or through the tract boundary pillars. This will afford drilling sites completely around the tract and near its center. At the present time, however, oil shale development is given preferential treatment under terms of the oil and gas unit agreement that prohibits conventional oil and gas development from precluding shale oil production. An environmental analysis has been approved for an oil and gas well immediately adjacent to the tract.

(ii) Core assay suggests that nahcolite and dawsonite associated with the oil shale over the height of the retort horizon is of sub-economic concentration. This same interpretation is felt to pertain to the entire oil shale sequence beneath the tract.

(iii) Pursuant to the lessee's revised Erosion Control and Rehabilitation Plan of June 17, 1977, U.S. Soil Conservation Service and lessee surveys indicate that there is sufficient native soil and soil-like material within the areas to be used for raw shale deposition to feasibly strip and redeposit over completed portions of the raw shale embankment up to 18 inches in depth. This will provide a satisfactory rooting depth and significantly limit infiltration of precipitation into underlying raw shale.

d. Recommendations

That all descriptions of the project area listed below be approved subject to implementation of a suitable development monitoring program as conditioned in Part 10.0 of this review:

Original DDP: Oil shale resources I-D-3, overburden Figure II-12, project area VII-XIII.

Modifications: Oil shale resources Figure I-D, resource recovery I-E-2.

Supplemental: Detailed Baseline Data Report Quarters 1-9, First Year Annual Summary and Trends Report.

Part 3.0, Overall Project Schedule

a. Basic Plan

Site Preparation	September - December 1977
Road Construction	
Water Storage	
Grading	
Fencing	
Preproduction Mining	
Shafts	
Engineering/Procurement	March - December 1977
Sinking	September 1977 - March 1980
Mine Development	January 1979 - Late 1982
Ancillary Facilities	
Initial Retorts	
Design	September 1977 - Sept 1978
Construction	March 1979 - March 1980
Operation	March 1980 - March 1981
Retort Cluster	
Design	March 1979 - April 1980
Construction	May 1980 - June 1981
Operation	July 1981 - April 1982
Commercial Facilities	
Design	August 1979 - August 1980
Construction	January 1981 - August 1982
Operation	Sept. 1982 - Life of Tract = 65 y

Manpower

1977	200	
1978	400	
1979	1180	
1980	1400	
1981	2580	
1982	2900	- dropping to 1800 with start of commercial operations
1983	1600	- estimated permanent work force

Disturbance (all types)

Year	Acres	
1	0	(±25%)
2	4	
3	114	
4	162	
5-10	100	
11-on	30-40	

Total through 2005 = 1,456 acres

b. Issues/Needs

(i) Detailed description of surface facilities and respective acreage and habitat/vegetation types affected.

(ii) Reclamation schedule for disturbed areas.

(iii) Location and habitat types affected by access, utility and product pipeline corridors.

(iv) Citing criteria for surface facilities appreciative of emission control.

(v) Manpower/skill breakdown.

(vi) Effect upon surface facility citing as a result of shaft relocations subsequent to submittal of plan modifications.

(vii) Abandonment schedule and plan.

(viii) Compliance with due diligence.

c. Resolution of Issues

(i) Figures III-A, B, and H in the Modifications Document depict major surface facilities from which the acreage disturbed can be scaled. These values are summarized in Table I-B. Additional scaleable figures depicting mine and surface processing facilities are included in the Ancillary Mining Plan submitted on June 17, 1977. Affected habitat types can be determined by comparing the aforementioned

figures with Figures XI-4 through 8, and XII-1 and 2 in Volume II of the original DDP environmental description. Such a comparison indicates that construction will disturb predominately chained pinyon-juniper ridge areas, while raw shale deposition will affect chained areas and sage and grass covered lowlands. The principal temporarily displaced biotic communities will be the migratory mule deer and domestic cattle which grazed on the tract. Habitat productivity will be restored during reclamation.

Condition (i) below, will make it incumbent on the lessee to provide final detail on all tract facilities before they are constructed. This will enable the Mining Supervisor to specifically evaluate in advance the exact nature and areal extent of the various facilities, their probable impacts, and ascertain whether there will be any inadvertent changes from the plan of action set out in the DDP as a result of subsequent detailed engineering activities.

(ii) The lessee has modified the original DDP Erosion Control and Rehabilitation Plan by letter of 6/17/77 to reflect changes in surface areas affected by in situ development. The reclamation schedule contained in this plan limits unreclaimed surface areas after year 5 to that used for permanent plant facilities and to no more than 100 acres of raw shale disposal area. This is necessary, based on the Ancillary Phase Air Pollution Dispersion Model (6/3/77) to meet fugitive dust control standards. Reclamation will require approximately 150 acre feet of water annually for dust control and initial irrigation of newly seeded areas.

(iii) At this time the lessee has not entered into any strong market commitments that would dictate probable pipeline routes. During the Ancillary Phase (through 1981) only about 5,700 to 6,000 barrels of shale oil will be produced daily. It is economically feasible to truck shale oil the distance to Rangely, Colorado, or as far away as Salt Lake City or Casper, Wyoming for refining or injection into common carrier pipelines. Trucking would use existing highway corridors. Once a definite pipeline

route is decided on, both the Mining Supervisor and BLM will be notified for their review and approval, respectively. Possible sources of electric power are better defined. During the Ancillary Phase, portable diesel generator sets will be used to provide the needed 4,615 KVA. The nearly 105,425 KVA needed during full scale commercial operation will be provided in whole or part by several alternate sources:

* On tract power generation using low Btu retort off gas;
* Connection to the north with the White River Electric line at a point near the confluence of Piceance Creek, or
* Connection to the east with the future 550-825 MVA Colorado Ute line between Meeker and Rifle.

Ideally, the tract would draw power from at least two sources to prevent complete loss of power should one source be temporarily down. Once the source is decided on, corridor planning would proceed in accord with and ultimately be approved under the BLM regional corridor development program.

Probable pipeline and powerline routes are further discussed in the original DDP and in the programmatic EIS.

(iv) Modeling of ancillary phase projected emissions (6/3/77) indicated that for other than valley bottom locations, there were no unique meteorological conditions that would restrict or dictate best locations for surface facilities along ridge lines. It was shown, however, that the areal extent of unreclaimed raw shale disposal areas should be limited to 100 acres or less in order to feasibly comply with particulate standards.

(v) By letter of 4/18/77, the lessee provided a complete skills breakdown of the 1,600 permanent employees. Revised population growth estimates for Rifle, Colorado, were provided on 7/25/77. Nature of impacts on Rifle and Meeker, Colorado are covered in the Socio-Economic Assessment Report submitted in March, 1976.

(vi) The Ancillary Mining Plan (6/17/77) indicated a shaft reorientation along a northeast trending axis to bring shafts and mine workings into proper alignment with the major joint-fracture set. This adjustment had little

effect on the relative location of the shafts with respect to the tract boundaries. Likewise, location of related surface facilities was little altered from that depicted in Figures III-A, B, and H, of the plan Modifications.

(vii) By letter of 6/28/77, the lessee provided a preliminary abandonment plan which follows essentially the same scenario used in the original DDP. Condition ii, below will require supplementing this abandonment plan emphasizing post retort stabilization and leaching control, based on information and operating experience gained during the ancillary phase.

(viii) Evaluation of projected production levels and timing in the DDP Modifications indicate that the lessee will surpass minimum royalty production at all times.

d. Recommendations

Approve all sections, as listed below, related to the overall development schedule subject to below listed conditions:

Original DDP: Surface facilities II-D, III-C; Abandonment schedule IV-K

Modifications: Schedule I-E-3, III-A and B, III-C-1 and 2, III-E-1, Figure III-4; Facilities III-C-3, III-E-4, III-D-2, Figures III-A and B; Disturbance Table I-B; Abandonment Plan I-E-1, III-E-11.

Supplemental: Ancillary Mining Plan Schedule of Facilites; Abandonment Plan letter of 6/16/77 re, retort stabilization, letter of 6/28/77 re, post operations, facility abandonment, and rehabilitation.

e. Conditions

(i) Prior to commencing any ancillary or commercial phase operations, the lessee shall submit final design plans, as requested by the Mining Supervisor, for his review as to adherence to the plan of action in the approved DDP and to Lease terms.

(ii) Prior to commercial phase development, the lessee shall supplement the abandonment plan emphasizing retort stabilization and control of leaching from raw and processed shale.

4. Part 4.0, Mining

a. Basic Plan

* Shafts

15-foot diameter ventilation/escape Shaft:

The shaft will be conventionally sunk or drilled to 1700' near the northeast tract boundary, concrete lined, and equipped as a temporary ore production and service shaft for the ancillary phase. During the commercial phase, this shaft will be used for auxiliary ventilation, emergency escape, and mine dewatering.

10-foot diameter temporary Gas Shaft:

This shaft will be situated in the general vicinity of 15 foot diameter shaft. It will probably be bored or upreamed to 1700 feet, cased and grouted, and will serve as the retort off gas shaft during ancillary retort testing. During commercial operation the shaft may be used for supplemental ventilation or ultimately sacrificed for additional retort development.

34-foot diameter Production Shaft:

This shaft will be conventionally sunk near the present ontract office facilities to

2,100 feet, lined, and linked by lateral drifts to the 12-foot diamter shaft before the ancillary retorts are kindled. During commercial operations, this shaft will be equipped with balanced 60 ton skips and serve as the main ventilation exhaust shaft for occupied mine areas.

34-foot diameter Service Shaft:

This shaft will also be conventionally sunk, adjacent to the above shaft, to 1,900 feet, smooth concrete lined, and equipped for hoisting mine equipment and personnel. During commercial operation, it will serve as the intake for process and ventilation air, emergency escape, and chambered to accomodate pipelines for mine water, power, retort steam, and fuel handling.

34-foot diameter Product Gas Shaft:

This shaft will be conventionally sunk near the center of the tract, smooth concrete lined to 1,850 where its only lateral connection will be made to the gas level. During commercial operation, it will serve as the dedicated retort off gas exhaust shaft connected through blower exhaust works to the surface gas treatment plant.

* Shaft Pillars

All shafts will be surrounded by at least a 500 foot radius pillar. The 34-foot diameter shafts will initially be surrounded by even larger pillars based on a 1:1 draw angle until more definitive rock mechanics data is acquired during ancillary phase testing.

Ancillary Phase

From laterals driven from the 15-foot diameter shaft and cross linked to the 10-foot gas shaft and to the 34-foot diamter production shaft, two commercial size retorts will be developed by either a vertical slot method (405' by 150' x nearly 300' high) or by a multi-level horizontal method (200' by 200' by 310' high). Bulk heads will be placed to connect the retorts bottoms to the 10-foot diameter temporary gas shaft, and retort off gas withdrawn by surface exhaust fans. In mine ventilation will be accomplished by auxiliary blowers. Mined material will be face crushed, conveyed underground by LHD's and/or belt conveyors to an ore pass leading to a skip loading station at the base of the 15-foot diameter shaft, thence to the surface where it will be truck hauled to the plant site fill area at the head of Cottonwood Gulch. Mine water will be pumped from a gravity sump near the base of the 15-foot diameter shaft. Product oil will also be pumped up the 15-foot shaft from sumps established in the lowest development level.

Surface facilities during the ancillary phase will include gas treatment, steam generation, headframes, truck loading stations, electrical generators and switch gear, fuel and product oil storage, waste treatment and disposal, water treatment and equipment storage and maintenance.

* Commercial Operation

During commercial operation, successive retort clusters will be developed by the method proved most practical during ancillary testing in panel units of 32 clusters each. Air level drifts (30' by 30') will be driven over the top of each cluster linking the 34 foot diameter production and service shafts. If the horizontal method is used, temporary retort access drifts (30' by 20') will be developed between these shafts and used to remove material from the retort chambers and for drilling and explosive emplacement prior to rubblization. This level will be bulkheaded off prior to retorting. Underlying the retort chambers will be a production level used to receive and transport mined out shale to the 34-foot diameter production shaft. Later it will be bulkheaded off under completed retort chambers and will serve as a conduct for product oil, gas and water. A gas production level (30' by 30') will be driven beneath the production level. The gas level will be successively connected to the overlying production level and bulkheaded as cluster development proceeds so that it is open only to the 34-foot

diameter gas shaft which will serve only for the withdrawal of non-condensable gases. If the vertical method is used, only the air, production, and gas levels would be mined. Cluster development will commence in the northwest corner of the tract with development on each level proceeding in conventional room and pillar fashion. Mined material will be face crushed, moved by LHD's and conveyors to ore passes to the 34-foot diameter production shaft skip pocket and thence to the surface. Ventilation will be achieved by exhaust blowers on the gas shaft with intake flow down the 34' diameter service shaft, circulated through the air level, and exhausted through the retorts to the gas level and shaft. Auxiliary blowers will supply air to occupied development levels which will be exhausted to the production shaft. Dewatering will be achieved through a system of three, 1.5 million gallon, gravity sumps with excess inflow above that needed for mine use pumped to the surface for treatment and release, reinjection, or evaporation. The mine will be equipped with a full complement of lighting, power, communications, safety, and maintenance systems.

Surface commercial mine facilities will be similar to those for the ancillary phase, except larger and centralized along the ridge at the head of Cottonwood Gulch.

b. Issues/Needs

(i) Mining Plan for the Ancillary Phase.

(ii) Mine orientation with respect to local geologic structural features.

(iii) Estimated rate of mine water inflow, dewatering rate, and system for handling excess flow above mine and surface needs.

(iv) Control of ground water movement into the retort zone.

(v) Sufficiency of retort and shaft pillarage.

(vi) Mine ventilation scheme in sufficient detail to illustrate a fail safe system and maintenance of negative pressure across retorts.

(vii) Probability and degree of subsidence, and procedures for monitoring its effects on mine structures and the surface.

(viii) Evaluation of mine rock mechanics and hydrology.

(ix) Effects of ground water re-entry on load bearing strength of rubble in retired retorts.

(x) Program for employee hygiene and mine health and safety.

(xi) Potential for future production of shale oil from strata underlying currently designated retort zone.

(xii) Sufficiency of rope guides in production shaft.

c. Resolution of Issues

(i) On June 17, 1977, the lessee submitted an Ancillary Phase Mining Plan with additional descriptions in the lessee's letter of July 8, 1977. Together, they illustrate the location and nature of mine surface facilities, revised shaft locations and sizes, shaft cross sectional layout, ventilation schemes retorting schemes, and mine health and safety procedures. The 15-foot and 10-foot diameter shafts have been reorientated along a subparallel axis to the principal northeast trending fracture pattern so that the temporary gas shaft is 200 feet southwest of the ventilation/ escape shaft. The two 34-foot diameter production and service shafts have been similarly reorientated and the shaft pillar around these increased to 1,275' in radius, pending further rock mechanics evaluation. Retort formation will be by one of two methods--multi-level or vertical slot. During ancillary testing, the most feasible of these approaches will be ascertained. All other aspects of

mining, haulage, hoisting, shaft use and ventilation will remain the same.

(ii) Like the shafts, underground workings have been reorientated from north-south, east-west alignment to a common centerline direction of N 20°E to roughly subparallel the major joint and fracture sets. This change has no significant effect on the location of surface facilities.

(iii) Tipton and Kalmbach, Inc., indicated in their letter of May 17, 1977, that estimated mine inflow would increase from 500 to 9,000 gpm over the first five years of operation and thence to a relatively steady inflow of 10,500 gpm by year 16 due to the established cone of groundwater depression. Energy Consulting Associates in their letter of May 19, 1977, presented estimates of inflow rates during shaft sinking by bed interval. Estimates of consumptive water use are only about 65% of that which may be produced. The remainder will either be treated and released, reinjected into aquifers of similar quality, impounded for evaporation, or a combination thereof. As part of the conditions for approval, under Water Pollution Control, the

lessee will be required to submit a detailed water management plan covering all water handling facilities and procedures for dealing with excess mine inflow. Occurances of excess inflow, if ever, would probably not occur until mine level development begins.

(iv) Rubblized retort chambers will act as their own drain to inflowing groundwater to be withdrawn along with product oil from sumps established in bulkheaded portions of the prodcution level. The lesses is in the process of investigating alternative retort water control plans, including establishment of dewatering wells perpherial to areas being developed and/or use of grout curtains. These plans, together with the above mentioned water management plan, will have to be submitted early on before major development begins.

(v) Shaft pillars, as described in the plan Modifications and supplemental Ancillary Mining Plan (6-17-77), will be no less than 500 feet in radius. The common pillar around the two 34-foot diameter commercial production and service shafts will be initially 1,275

feet in radius. This will provide a nearly 1:1 draw angle to the nearest mine workings until ancillary phase rock mechanics test can more closely define the safe, minimum shaft pillar radius. Pillarage between individual retorts is minimal and thick enough only to control gas flow. It is intended that the retort pillars will crush out, in time transferring full overburden load to the bulk full rubbled retort columns allowing overlying strata to uniformally subside.

(vi) The Ancillary Phase Mining Plan of June 17, 1977, contained diagrammatic material illustrating the ventilation flow scheme during all major ancillary development and operational phases. The system will evolve from a push-pull scheme during shaft sinking to an exhaust pull system out of the 10' diameter temporary retort gas shaft supplemented as needed by in mine fans. Commercial operations will also use the exhaust pull system out the 34' gas shaft. This scheme will maintain a 4 inch pressure drop across the retorts. If for any unforeseen reason retort pressure becomes positive, electro-mechanical valves in the

air supply boreholes between the air level and tops of the retort columns can be remotely closed and gas pressure bled off through the steam injection system and by-passed to a surface flare.

(vii) The lessee held a briefing for the AOSS and U.S. Bureau of Mines, May 17, 1977, on mine stability and subsidence. It is estimated that transfer of overburden load to bulk full rubbled retort columns may result in 3 to 9 feet of surface subsidence before permanent stability is reached. Retort pillars are intended to uniformally fail to the same degree, thus maintaining the integrity of the overlying sill pillar, air level and overburden. Subsidence will be monitored by replicated level surveys over an established network of stations. Basic concepts and timing of subsidence measurement are outlined in the lessee's letter of June 28, 1977. As presently understood, plastic deformability of overlying strata will greatly subdue any surface expression of subsidence that will be largely undetectable, except by careful survey.

(viii) The letter of June 28, 1977, contains a schedule for rock mechanics tests to be completed by 1981. These tests will evaluate pillar parameters and failure potential. The lessee will also be required, as part of their development monitoring program, to maintain records on subsidence, integrity of mine structures, and mine hydrologic regime.

(ix) Both the U.S. Bureau of Mines and ERDA's Laramie Center are carrying out chemical and physical tests on samples of in situ retort shale from Oxy's D.A. Property. These tests are aimed at defining the physical strength and load bearing capacity of retorted shale, as well as its mineralogical composition. Preliminary results suggest that sufficient temperature and residence time are achieved to fuse most of the soluable minerals into new crystalline forms resembling igneous assemblages. This will significantly reduce their soluability and will enhance structural strength. Furthermore, the retorts will remain connected to the production-gas levels over life of the operation. Thus inflowing water will be drained away before persistent

residence might causes the pH to elevate to levels where silicate dissolution occurs. The lessee will be required by conditions stipulated for water pollution control to carry out a processed shale leaching study. This will provide information on long-term shale leachability and strength from which permanent abandonment procedures can be developed.

(x) The lessee's letter of June 28, 1977, outlined the mine health and safety program responsive to MESA and Colo. Div. of Mines standards; safety training, inspections, medical facilities, industrial hygiene, ground control, fire prevention, ventilation, dust control, evacuation, maintenance of equipment, and explosives handling. On June 21, 1977, C-b briefed MESA and Colorado Bureau of Mines on mine safety procedures.

(xi) The lessee has indicated that modified in situ development will not preclude future recovery of underlying oil shale, provided economic and technical problems of working at increased depth are resolved. Existing shafts could be deepened and surface facilities

upgraded for continued tract operation.

(xii) MESA has no reservation regarding use of rope guides. A special permit from the State of Colorado will be required.

Recommendations

That all sections of the original DDP, modifications, and supplemental material, listed below, pertaining to mining be approved:

Original DDP: surface facilities II-D; mine development II-F-4; communications II-G-4 and IV-C-10; shaft dewatering II-M-1; mine water supply IV-C-10.

Modifications: surface facilities III-C-3, mine development III-C-4, I-E-1, and III-D-1+3; lighting III-D-5; dewatering III-D-5 and III-E-Z; compressed air III-E-6.

Supplemental: Ancillary Mining Plan; letter of 6/28/77 re, rock mechanics, subsidence evaluation, retort shutdown, retort abandonment, employee health and safety;

letter of 7/8/77 re., ancillary mining; letters of 4/5/77, 5/17/77, 5/19/77, and 6/9/77 re., dewatering rates, permeability, and aquifer discharge.

5. Part 5.0, Processing

a. Basic Plan

For both ancillary testing and commercial operation, retort development will follow essentially the same pattern. Retort rubble columns will be formed by drilling and explosive rubblization of shale between the mine development levels or along the verticle retort development slot. Development levels will then be bulkheaded around the periphery of each retort cluster. Boreholes will be drilled into the top and bottom of each retort from the overlying air level and underlying production level. The production level will then be connected to the underlying gas level and bulkheaded so that development of adjacent clusters can proceed. The retort are now kindled by lowering oil burners down the boreholes from the air level. Once ignition is achieved, combustion is sustained by air flow and steam injection from the air level. Negative retort pressure is maintained by exhaust blowers in the gas shaft pulling gases out the retort bottom through the connected production and gas levels. Retorts will be operated until the flame front reaches a predetermined level near bottom of the retort, at which point air and steam flow will be cut off. Any latent gas and liquids generated will continue to flow to the production and gas levels and be withdrawn over the life of the operation. Emergency retort shutdown can be achieved at

any time by activating remote control valves to shut off air and steam inflow. Auxiliary generator sets will insure exhaust blower operation in the event of power failure from off-tract sources or from on tract low Btu gas combustion. Should the retort exhaust stream become blocked, back pressure will be relieved through the steam injection system to a bypass flare.

Ancillary testing will entail operation of two full scale retorts followed by a cluster of four. Product oil and gas will be gravity separated behind the bulkheads in the production level with the gas withdrawn out the 10-foot gas shaft, and residual oil and water pumped through the gravity sump bulkheadsand out the ventilation/escape shaft to surface treatment facilities. These facilities will consist of exhaust blowers, H_2S and hydrocarbon removal equipment, thermal oxidizers, oil-water separators, heater-treaters, and 10 days of tank storage. Through put will range from 2,500 to 6,000 bbl/day. Steam for retort operation will be generated by fuel oil fired boilers at the rate of 85,000 to 129,000 lbs. per hour, depending on the exact size of retorts developed. All steam piping will conform to ASTM standards and ASME codes and be hydrotested to 1-1½ times working pressure.

During commercial operation, 40 retorts will be operated together to produce 85,000 bbl/day oil and water

and 1 million cubic feet of gas per minute. This will yield 57,000 bbl/day shale oil after surface treating and will require injection of 850,000 lbs. of steam per hour. Over tract life, 15 panels of 32 retort clusters each will be retorted. Product gas will be exhausted up the 34' diameter permanent gas shaft, while oil and water will be withdrawn from gravity sumps and pumped up the main service shaft where both will be treated similarly to the ancillary phase, except that off gas will be used to fire the steam boilers and to possibly operate low Btu gas power generation facilities.

b. Issue/Needs

(i) Retort shutdown procedures under normal and emergency conditions.

(ii) Retort product oil collection system.

(iii) Retort steam handling system.

(iv) Composition of retort off gas.

(v) Retort efficiency relative to overall resource recovery.

(vi) Physical, chemical, and leachability characteristics of retort shale.

(vii) Probable methods of retort development and related pillar dimensions.

(viii) Beneficial use of residual heat in exhausted retorts.

(ix) Need for upgrading of product oil.

(x) Potential for surface retorting of mined shale.

(xi) Occurence of nahcolite and dawsonite in retort zone.

c. Resolution of Issues

(i) In the letter of June 28, 1977, the lessee outlined procedures for emergency and normal retort shutdown. In either case, air regulator valves in the boreholes connecting the top of each retort with the overlying air level would be manually or remotely closed. Retort gas production would immediately drop to 20% and continue to fall off over the next several days. Latent gas, oil, and water would continue to drain into the underlying production/gas levels and be removed from the mine by the off-gas blower and product oil sump pumps. Sumps are sufficiently large to accommodate up to several days production without pumping should a complete pumping failure occur. If the production boreholes in the bottom of a retort become plugged, or the gas level or shaft become blocked, or a complete exhaust blower failure occur, air flow to the operating retorts would again be remotely shut off by

closing the air regulators and temporary gas back pressure bled off through the steam injection system that can be shunted, under such conditions, to an emergency gas flaring system.

Continuous gas monitors in occupied mine working will detect retort gas leaks and set off multi-sensory alarms. Warning will occur at levels well below toxic threshold.

(ii) The Ancillary Mining Plan depicted the product oil recovery procedure. Oil and water will flow from the bottom of each operating retort through raise bored holes into the production level, which is bulkheaded off from areas under active develop. The production level will gently slope to the north due to the natural dip of the bedding. Oil and water will flow down dip and accumulate behind strategically located bulkheads. From there, it will be drawn off to one of three major collection sumps sized to hold several days worth of continuous production. From there, it will be pumped to the surface separation and treatment plant.

(iii) The steam handling system is described in the lessee's letter of 6/28/77. During ancillary testing fuel oil fired boilers will provide up to 129,000 pounds of steam per hour. This will be increased to 850,000 pounds per hour during commercial operation from retort off gas fired boilers. Steam will be piped to the active retorts through a system of piping meeting ASTM standards; ASME piping codes. Pipes will be shielded and insulated down shafts and along occupied mine works for personnel protection should a leak develop. The steam injection pipes into each retort are sealed to below the air regulators so that under emergency conditions any retort gas back pressure can be bled off through the steam lines to a surface flare.

(iv) As a confidential submission, the lessee provided analysis of off gas composition from Room 4 at the OXY, D.A. property, Analyses indicated no concentrations of hazardous trace elements or sulfur compound concentrations in excess of available treatment system capabilities to clean up to statutory emission standards.

(v) Retort efficiency has been estimated by the lessee as 40% across the height and breadth of the 310 high retort horizon, and 70% efficiency within any given retort. The U.S. Bureau of Mines has computed the efficiency at only 23% if the interval from the top of the air level to the base of the gas level is considered over the breadth of the tract. This low value is the result of unretorted resource left in the sill pillars between the air level and top of the retorts, and between the bottom of each retort and successively lower production and gas level. Currently planned in situ development will produce 1.2 billion barrels of shale oil vs. only 400 million barrels by room and pillar/surface retorting methods previously planned.

(vi) The lessee has submitted to the AOSO a confidential report on the composition of in situ retorted shale from OXY's 1-E retort. Information contained in that report and in a preliminary evaluation of samples analyzed by ERDA suggest that most of the carbonates are tied up in low igneous minerals generated by the sustained high temperatures in the retort combustion

zone. These minerals, principally augite, are no more soluble than constituents of raw shale. The U.S. Bureau of Mines is presently running various physical tests on samples of in situ retorted shale that will provide valuable information on compressive and load bearing strength.

Appreciative of the importance of shale composition as relates to long-term groundwater quality and substrata stability the lessees have submitted plans for field and laboratory leachability studies. Furthermore, approval of the DDP will be conditioned on the lessee preforming detailed mineralogy and leachability studies on ancillary phase retorted shale from Tract C-b prior to commencement of commercial development.

(vii) The Ancillary Mining Plan depicts two principal retort development schemes. Retorts can be developed by driving multiple mine levels (3) across the breadth of the tract to remove shale for required rubble void volume. From these levels intervening shale within each retort would be drilled and explosively

rubblized. Retorts can also be developed by raise drilling from the air and production levels and explosive formation of a vertical slot across the height and length of the retort chamber. Muck would be removed through draw points into the production level in a manner similar to block caving. Blast holes would then be drilled from the air level into the shale which would be explosively rubblized toward the slot tree face. This procedure would eliminate the need for intermediate levels and no personnel would ever have to enter the retort chambers. Pillar dimensions are considered confidential information by the lessee as they are a key factor in the patentable aspects of the OXY in situ process. Pillar dimensions have been submitted as confidential data to the AOSO. Retort pillars are designed to crush out, transfering full overburden load to the bulk full retort rubble columns.

(viii) The lessee has indicated that beneficial use of residual retort heat will be investigated. Retired retorts may also be used as part of the retort off gas treatment stream or to preheat incoming retort air.

(ix) At present, the lessee does not intend to upgrade raw shale oil on tract. Characteristics of raw in situ shale oil are such that it can be successfully pipelined to a central refining facility.

(x) The lessee has indicated that continued evaluation of the economic and environmental feasibility of surface retorting mined shale will be carried out. Conditions of approval will further require that related feasibility studies be completed as part of the final raw shale disposal plan.

(xi) There is no indication of sufficient nahcolite or dawsonite in the interval to be retorted to warrant economic extraction.

d. Recommendations

That all aspects of the original DDP, Modifications and supplemental material listed below relating to processing be approved as conditioned:

Original DDP:	steam system IV-I-2.
Modification:	retorting I-E-1, III-D-3, III-E-2. Figures III-f, G, and J; steam system III-E-6.
Supplemental:	Ancillary Mining Plan; letter of 6/28/77 re., retort operation and steam handling.

e. Conditions

(i) The lessee shall incorporate the best practical commercially available control technology in all phases of ancillary and commercial development.

(ii) Prior to commercial development, the lessee shall submit a detail evaluation of ancillary retort off gas composition.

(iii) The lessee shall continue to evaluate techniques for underground disposal of mined shale and/or feasibility of surface retorting.

6. Part 6.0, Overburden and Shale Handling

a. Basic Plan

* Overburden and Shale Handling

Material produced from shaft-sinking will be crushed and used for surface plant site construction fill material (Figure III-A) at the head of Cottonwood Gulch.

Material produced during the development of mine level stations, drifts, access ways, service areas, and retorts will be crushed at the mine face, hoisted, and distributed over on tract gulch areas by a conveyor placement system.

Cottonwood Gulch - 65 million tons to an elevation of 6,900 feet will handle all material from initial development and ancillary testing plus 3.6 years of full scale production.

Sorghum Gulch - 212 million tons to an elevation of 7,000 feet will handle 11.6 years of full scale production.

Stewart, Scandard and other gulch areas - 600 million tons for an additonal 40 years. An alternative to completely filling these gulches would be to return a portion of the mined shale underground. This would reduce revegetation needs, although water requirements might increase for slurry transport.

Prior to commencing major excavations, areas to be filled or cut will be cleared and/or grubbed to remove all vegetation and topsoil. The latter will be stockpiled and used later for reclamation.

Figure I-B, in the Modifications, the time table for acreage disturbance.

* Revegetation

The following items will be investigated as a prerequisite to the revegetation test program:

* particle size and soil compaction;
* leaching requirements;
* minimum requirements for plant nutrients and most effective method of application;
* necessity for seed bed mulching;
* minimum irrigation requirements and frequency;
* plant material combinations; and
* weathering of shale waiting to be vegetated.

Results of these evaluations will be used, with the proper time table, to test and ultimately revegetate the raw oil shale embankments.

b. Issues/Needs

(i) Amount of raw shale destined for surface depositiion, characteristics of this material, feasibility of grade segregation and other depositonal procedures to accommodate future

recovery and retorting, implacement methods, shaping, and rate of reclamation.

(ii) Apparent discrepancy in raw shale depositional rate for the first 10 years and subsequent implacement for the next 18 years.

(iii) Auto-oxidation potential of raw shale embankments.

(iv) Feasibility of underground disposal of raw shale.

(v) Leachability of raw shale.

(vi) Availability of topsoil-like material for aiding in the reclamation of raw shale embankments.

c. Resolution of Issues

(i) By letter of June 28, 1977, the lessee submitted a Raw Shale Disposal Plan. This plan, like Section V.H of the of the Modifications, indicated that approximately 725 million cubic yds. of raw shale would be mined for in situ development vs. 370 million cubic yards for the original DDP underground mine and surface retort scheme. This material however, will be mined at about 41,000 Tpd as opposed to 60,000 plus Tpd, over a 60 year tract life as

opposed to less than 20 years under the original development plan. Mine run material will be coarse, averaging 8 inches or finer as it comes from the face feeder-breakers. No addtional crushing on the surface is planned. Particle size is roughly estimated to be:

62%	+ 1/4 inch
26%	very coarse sand
6%	medium to coarse sand
3%	fine sand
3%	silt to clay size

Chemically, this material can be described as:

High pH, similar to mature soil.
Low saturation
Moderate conductivity.
High sodium.
Low nitrogen as ammonia.
High carbonates.
Low calcium and magnesium.
High exchangeable potassium.
Low phosphorous.
High flourine.

The coarse texture will result in poor water holding capacity, but planned reclamation procedure of blanketing completed portions of the raw shale embankment with native soil and soil like material will mitigate this, as well as low nutrient levels.

Mine run shale will be a mixture of oil shale grades across the height of the active workings. This will result in an aggregate grade of 24 to 27 gallons per ton,

which is more than acceptable feed grade for surface retorts, eliminating the need for grade segregation prior to deposition. When it becomes economically feasible to surface retort the shale, large front end loaders and a system of truck-conveyor haulage could be used to reclaim the raw shale. Operating characteristics of this equipment, as demonstrated at surface coal mines, are not particularly sensitive to the configuration of material being excavated. This will allow ultimate bank stability and contouring for habitat restoration to be of first consideration in shale deposition. The small amount of mined shale that will be unreclaimably used for plant site fill or dam construction will amount to .0008 of the total yardage brought to the surface and a correspondingly insidnificant portion of the total shale oil that could be had from surface retorting.

Raw shale will first be deposited in Cottonwood and Sorghum Gulches and then other on tract depressions by a system of conveyors. Material will move from the hoist surge bin through wide apron feeders onto 4,000 STPH capacity long belt conveyors, thence through out bound surge bins and along additional conveyor flights to skid-mounted shiftable belts equipped with self-propelled, rail mounted trippers feeding portable truss conveyors that will spread the shale in a fan like pattern along the active down gulch bank face. Final spreading, shaping, and blanketing with previously

scarified and/or stockpiled topsoil and soil like material will be accomplished by wheel-mounted scrapers and dozers.

Dust control is not anticipated to be a significant problem due to the ambient free mositure (3 to 5%) in the mine run shale. Nevertheless, all transfer points will be enclosed and equipped with water sprays. Additional wetting will be employed as needed, at the points of active deposition. Temporary irrigation of completed bank areas or the use of chemical soil sealents will farther control wind erosion.

Disposal of the below indicated quantities of raw shale will fill the respective gulch area essentially level with surrounding ridges.

Cottonwood Gulch	106,300,000 cubic yds	8.6 yrs
Sorghum Gulch	143,300,000 cubic yds	11.6 yds
Scandard and Stewart Gulches	Remaining tract life.	

Average increase in raw shale embankment by year:

Year 1	0 acres	
2	15 "	
3	20 "	
4	75 "	
5	100 "	
6-10	100 "	dropping to 30 acres annually thereafter due to deepening gulch topography.

The Reclamation schedule, contained in the revised Erosion Control and Rehabilitation Plan, will limit unreclaimed bank surface areas to no more than 100 acres. Limiting unreclaimed acreage is essential to meeting fugitive dust

standards.

Raw shale embankment out slope stability will be maintained by a series of regularly spaced back sloping terraces and drainage flumes.

(ii) During the first 10 years of raw shale deposition, new bank surface area will increase up to 100 acres annually. Thereafter, it will drop off to approximately 30 acres per year due to down drainage movement of the active bank face into topographically deeper gulch area.

(iii) In their letter of March 24, 1977, Colony Development Operation reported that no spontaneous fires had occurred in the one million ton raw shale pile (33 gpt average grade) since its emplacement in 1965. The only fire observed is occurring in a pile of -1/2 inch raw shale dumped HOT from the TOSCO II semi-works retort preheater in 1972 when the retort was shut down. It can be speculated that combustion initiated in this pile because the shale had been heated to near retort temperatures before being dumped. Lack of abundant pyrite and an arid climate will greatly limit exothermic heating due to sulfide oxidation, further

limiting the potential for spontaneous ignition.

(iv) The lessee has indicated a committment to examine the feasibility of underground disposal of mined shale. Conditions for approval will make it obligatory on the lessee to carry out appropriate backfilling investigations prior to commencement of surface deposition.

(v) The lessee, by letter of July 1, 1977, outlined a program to evaluate the leachability of raw and processed shale. Conditions for approval will make it manditory that such investigations be carried out on raw and processed shale from tract C-b and that the results be reported to the Mining Supervisor prior to commencement of commercial operations.

(vi) Estimates made by the SCS and reported in the Erosion Control and Rehabilitation Plan of 6/17/77, indicate that there is sufficient, strippable, soil and soil-like material in the raw shale disposal areas to blanket completed portions of the shale embankment up to 18 inches deep.

d. Recommendations

That all applicable aspects of the original DDP,

Modifications and supplemental materal, listed below pertaining to overburden and shale handling be approved subject to the below stated conditions:

Original DDP:	Overburden V-G and H.
Modification:	Mined Material III-D-4 and III-E-3; Overburden Table I-B V-G and H;
Supplemental:	Letter 6/28/77, re: Raw Shale Disposal Plan; letter of 6/17/77 re: Erosion Control and Rehabilitation Plan.

e. Conditions

(i) The lessee shall supplement the raw shale disposal procedures, submitted as supplemental material to the Modifications, by providing a final description of the raw shale disposal sequence, grading, and surface contouring prior to commencement of any surface deposition. The description shall include procedures for any planned disposal of liquid and solid wastes with the raw shale. The lessee shall also continue to investigate feasibility of underground disposal and/or surface retorting.

(ii) The lessee shall evaluate and report on the leachability of raw shale prior to commercial

phase operations emphasizing mobility of trace and toxic constituents.

(iii) As part of the abandonment plan, the lessee shall include plans for control of long-term leaching from raw shale embankments, unless previous studies indicate that leaching does not pose a significant environmental impact.

7. Part 7.0, Access and Service

a. Basic Plan

Roads

Initially, the existing access road will be improved and paved to the plant site limiting maximum curvature to 5% and maximum grade to 6%. This will require approximately 8 acres of land. Graveled service roads will require an additional 3 acres of land. During scale up to commercial operations, the main tract access road will be further improved, requiring an additional 20 acres and service roads will be extended using 9 more acres.

Pipelines

Curently, the most promising shale oil market area would be the northern states. A suitable pipeline corridor could extend north and east connecting with pipelines either in the vicinity of Casper or Guernsey, Wyoming, or Rangely, Colorado.

All pipelines will be designed in compliance with the Department of Transportation regulations, Title 49 CFR, Part 195.

A 50,000 bbls/day operation would require a pump station on tract equipped with two 900 hp pumps (one being used for standby). Temperature, flow rate, and pressure will be monitored. Pressure alarms will be used to indicate upsets or line failure.

All filled areas along the right of way will be thoroughly compacted and stabilized to minimize erosion.

The entire pipeline will be coated and wrapped to protect against corrosion and hydrostatically tested.

Fuel Supply

An interlocking valve system will isolate the surface diesel fuel storage tanks from the measuring tank. Fuel will be dispatched to the mine in batches. During fuel transfer operations, constant telephone communication will be maintained. The pipeline and measuring tank will contain no fuel except during attended fuel transfer operations. Fuel storage underground will be limited to a one day supply.

Electric Power

Ancillary Phase - Power will be generated onsite with diesel generator sets totaling about 10,000 hp.

Commercial Phase - It will be necessary to expand onsite generation using low Btu retort off gas or to construct powerlines to an offsite power source.

New conductors could be installed on existing powerlines to provide a maximum capacity of 10,000 KVA to meet early stage power requirements.

Construction of a full-capacity electrical transmission line to and on Tract C-b will require about 2 years for design,construction, and tie in with existing main lines

along the White River or between Meeker and Rifle. Modifications Table III-C gives power requirements for the full scale mine and surface facilities (105,425 KVA).

Two major areas requiring electrical power are the underground mine and support facilities, and the surface in situ gas and oil treatment plant (35,075 and 70,350 KVA, respectively).

System design and hardware must meet all applicable Federal and State regulations for underground nonmetallic mines.

Water Supply

Shaft and mine dewatering will probably supply all necessary operational needs. Mine water will be used for dust control, steam generation, other process requirements, and domestic needs. Any surplus water will either be impounded in Cottonwood Gulch, reinjected into subsurface aquifers of similar quality, treated and released to Piceance Creek, or some combination thereof. The 5-foot diameter ventilation/escape shaft, near the north tract boundary will serve as the main collecting and pumping facility for mine water. Surplus water will be returned to retired retorts only if it will not pollute ground water supplies.

Water requirements for development listed in Section III-E-8 of the Modifications are:

	Mine H_2O Available (gpm)	Water Usage (gpm)
Initial Retort Development	400-1,000	310
Retort Cluster Development	800-2,000	460
Commercial Operation	2,000-10,500	3,600

Dams/Impoundments

An existing retention basin and a starter dam to be built in Cottonwood Gulch will provide initial storage for excessing ground water from shaft and initial mine development.

When completed, Cottonwood and Sorghum Gulch Dams will be of earthfill construction to a height of approximately 80 feet with a capacity of approximately 600 acre feet. They will serve as catchment areas for storm runoff from the mine surface facilities, raw shale embankments, and as storage dams for mine water. A carnation system will be used to divert runoff around the raw shale disposal areas and into the impoundments. Water from catchment ponds above the Sorghum Gulch shale embankment will be used for shale dust and compaction control. Sour water, heavily mineralized blow down from gas and water treatment, and other polluted sources will be retained in a special, seepage tight impoundment on the ridge west of Sorghum Gulch.

Communications

A PBX multistation telephone communication system will be provided for offsite and inplant communication. Replicated alarm systems for fire, mine blasting warnings,

and similar alarm conditions will be installed in underground and surface areas. Radio communications will be installed to provide contact between mobile equipment and the communications center.

b. Issues/Needs

(i) Location and design characteristics of main tract access road.

(ii) Location of utility corridors (pipeline, powerlines, etc.).

(iii) Source of electric power for tract development during normal and emergency conditions considering beneficial use of low BTU retort off gas.

(iv) Overall water budget stressing nature and amounts of consumptive use.

(v) Description of surface water handling facilities including dams and impoundments, treatment, disposal methods, flow augmentation, and protection of vested water rights.

(vi) Design contingency for excess mine water inflow above that currently planned for.

(vii) Citing criteria for tract facilities appreciative of emission rates and prevailing meteorological conditions.

c. Resolution of Issues

(i) The lessee, in parts III-D-9 and III-E-10 of the Modifications and in response to AOSS questions have confirmed that the main tract access road will follow essentially the same alignment as the present graveled road. A centerline survey is now being conducted. Grades and curves, however, will be modified to accomodate a two lane, paved road with a maximum grade of 6% and curvature of 5%. The only uncertain aspect at present is where the road will tie into the county road along Piceance Creek. This will require crossing private land, unless BLM exercises condemnation authority over adjoining section corners which would insure unrestricted public access to the tract and vicinity. The matter is currently being investigated by BLM and is legally beyond the lessee's power to resolve.

(ii) No firm committment has been made by the lessee regarding off tract powerline and pipeline locations. Until such time as a committment can be made, the lessee will proceed with development using power from mobile generator

sets. These may later be replaced by permanent on tract generating facilities using the low BTU retort off gas that has no commercial value. Similarly, no committment has been made for off tract product pipeline corridors, although the most logical alternative is to move shale oil north to Casper, Wyoming, thence by existing common carrier pipeline to northern state market points. During the Ancillary Phase, tank trucks will be used to move the 6,000 barrels of shale oil produced each day to either Casper, Salt Lake, or to Rifle for rail loading. Final pipeline and powerline corridor selection will have to be coordinated with and approved by BLM through their regional corridor planning program.

(iii) As explained, above, ultimate source of commercial electric power has not been fully resolved. Until such time, portable generator sets will be used. Emergency generators will also be included among permanent tract facilities to provide power to critical mine ventilation fans, man hoists, safety devices, product sump pumps, and off gas treatment circuits in

the event of failure of off tract power sources or on tract generating equipment.

(iv) Preliminary water budget estimates are present in Figures III-G, F, and J of the plan Modifications. During the Ancillary Phase, mine inflow will yield between 500 and 1,500 gpm of water per 1,000 barrels of daily production. Of this amount, approximately 460 gpm will be treated for utility and process use with about 30 gpm ultimately returned as blowdown to waste water ponds. The remaining 540 gpm per 1,000 bbl/day shale oil will either be used for reclamation purposes, impounded, treated and released, reinjected, or some combination thereof. During commercial operation,up to 65% of the estimated 10,500 gpm mine inflow will be consumptively used with up to 150 acre feet required annually for reclamation. The remainder will be handled in the same manner as excess flow during the ancillary phase. The lessee will be required by condition of approval to submit revised water budget estimates prior to commencing any operations, reflecting the latest calculated data.

(v) As described in the plan Modifications, dams will be constructed in Cottonwood and Sorghum Gulches, near the north tract boundary, to retain excess mine water and drainage from the raw shale embankments pending ultimate treatment and disposal. In addition, a sour water basin will be built along the ridge north of the commercial gas treatment facilities. Waste water treatment would use any of a number of commercially available processes with ultimate disposal by evaporation, release to Piceance Creek, or reinjection. Surface flow augmentation to protect vested surface use rights would be accomplished by release of treated water or importation of water from the White or Colorado Rivers. The lessee, pursuant to conditions for approval, will have to provide, prior to commencement of construction activities, specific details for an overall water management plan that will describe planned water handling facilities.

(vi) Specific details for handling excess mine inflow above the maximum 10,500 gpm currently used in design parameters will be included in the water management plan required by the conditions for approval.

(vii) Air quality modeling performed for the Ancillary Phase submitted on 6/10/77, and as further supplemented by the "Air Quality Control Plan" of 7/21/77, indicate that facility citing is not significantly dictated by prevailing meteorological conditions provided valley bottom areas are avoided except for impoundments and raw shale disposal. Unreclaimed surface area of the latter, however, should not exceed 100 acres in order to meet fugitive dust standards. The reclamation schedule contained in the revised "Erosion Control and Rehabilitation Plan" of 6/28/77, states that unreclaimed raw shale embankment area will be limited to no more than 100 acres annually.

d. Recommendations

That all applicable sections of the original DDP, Modifications, and supplemental material, listed below, pertaining to access, utility corridors, fuel and water supply, impoundments, and communications be approved subject to the stated conditions for approval:

Original DDP: Roads II-J; Pipelines III-D-2 and 6 and IV-J; Fuel Supply III-G-5 and IV-C-10; Water Supply I-D-6, III-D-2, and IV-C-10; Impoundments

II-K, III-C-5, Table III-3; Communications III-D-4.

Modifications: Roads III-D-9 and III-E-10; Pipelines III-E-5 and Figure III-L; Fuel Supply III-E-6; Electric Power III-D-5, III-E-5 and 6, Figures III-A, B, C and K; Water Requirements III-E-6; Water Supply I-E-1, III-D-5, III-E-2 and 5, IV-D, and Figures III-G, F, and J; Impoundments III-D-6 and III-E-7; Communications III-E-5 and 6.

Supplemental: Pipelines, letter 7/8/77 re., marketing for ancillary phase; Water Requirements, letter of 6/28/77 re., rehabilitation plan; Water Supply, letters of 4/5/77, 5/17/77, 5/19/77 and 6/9/77 re., dewatering and permeability.

e. Conditions

(i) Prior to commencing any operations under the Ancillary Phase the lessee shall submit final design plans for approval by the Mining Supervisor as to adherence to Lease terms. This shall be interpreted to include all plans relative to on tract roads and utility corridors.

(ii) The lessee, prior to commencement of construction activities, shall submit a detailed water management plan, describing, among other things, surface water handling facilities, impoundments, seepage control, contingency for excess flow, and surface flow augmentation plans required under Colorado water law.

8. Part 7.1, Off Tract Corridors

a. Basic Plan

The preferred road corridor would extend north from Rifle along State Highway 13, west along the county road down Piceance Creek, and south along essentially the same right-of-way as the current, graveled tract access road. The latter will be widened, brought to specified grade and curvature standards for class "D" road, and paved. Selection of powerline corridors will be the responsibility of utilities providing the service in cooperation with BLM under their regional corridor planning program. Most likely power sources would be the White River Electric line to the north along the White River and/or the proposed Colorado Ute line to the east running between Meeker and Rifle. Product pipeline corridor is currently undecided pending further definition of the market area. The most promising alternative being considered goes to the north and east to connect with a common carrier pipeline near Casper or Guernsey, Wyoming, and thence to northern state market points. If necessary, water for flow augmentation would be brought by pipeline from either the White or Colorado Rivers.

b. Issues

(i) Lessee's position regarding future public use of main tract access road.

(ii) Discusssion of corridors and location of facilities is lacking. Insufficient information for BLM planning.

c. Resolution of Issues

(i) Lessee response of June 15, 1977, indicates that the main tract access road will be within the same R/W area as the existing access road. The lessee is negotiating with BLM regarding the access road R/W across public land north of the tract and the point at which it will tie in with the county road along Piceance Creek. The lessee will provide open Public access on tract with specific safeguards around hazardous areas. The lessee, however, does not wish to interfere with the matter of access across private land and its implication of unrestricted access to the tract area.

(ii) Lessee response of June 15, 1977, indicate that the lessee is evaluating the location, design, and construction of off-tract facilities. All considerations for the location of the off-tract corridors have not been resolved, and negotiations will take place with BLM during the decision process. Corridors for pipelines and powerlines are not required

during the ancillary phase as the lessee plans on using moble generator sets and trucking retort products to regional refineries. All off-tract corridors are subject to BLM approval processes.

d. Recommendation

All off-tract corridors are subject to review by the Mining Supervisor, however, ultimate approval lies with BLM and local governments.

9. Part 8.0, Environmental Control Plans

a. Basic Plan

The elements of the environmental control plans contained in the Modifications are the same as the original DDP. The change to a modified in situ process is reflected by some changes in the individual control plans. Included are the following specific plans:

Air Pollution Control
Water Pollution Control
Noise Pollution Control
Protection of Objects of Historic, Scientific, Aesthetic Value
Fire Prevention and Control
Health and Saftey
Overburden Management
Raw Shale Storage
Disposal of Other Wastes
Fish and Wildlife Management Plan
Erosion Control and Surface Rehabilitation
Spill Contingency Plan
Off-tract Corridors

b. Issues

(i) Environmental control plans should be revised because of new technology.

(ii) Plans should utilize best control technology.

c. Resolution of Issues

(i) Control plans have been supplemented by the Modified DDP and additional lease submissions. The Fish and Wildlife Management Plan and Erosion Control Plan were revised on June 17, 1977,

and the Air Pollution Control Plan was revised on July 21, 1977. Preliminary plans for retort operation and abandonment, raw shale handling, steam systems, and the like have also been submitted. Conditions for approval will make it mandatory that these plans be supplemented with specific details prior to scale up to commercial oeprations.

(ii) Conditions for approval will also make it mandatory that all environmental control plans incorporate the best, practicable, commercially available control technology and that all plans be reviewed and revised, as needed, prior to commercial phase development.

d. Recommendations

That all environmental control plans, summarized in the following review sections be approved subject to the general conditions below and specific conditions cited in the following sections:

e. Conditions

(i) Environmental control plans shall be reviewed and revised as needed based on information from the Ancillary Phase prior to implementation of the commercial phase development.

(ii) That the lessee incorporate the best, practicable, commercially available control technology in all phases of ancillary and commercial development.

10. Part 8.1, Air Pollution Control

a. Basic Plan

Critical emissions are particulates, sulfur dioxide, carbon monoxide, total hydrocarbons, and oxides of nitrogen. Emissions for all pollutants based on back calculation from modeling done for original DDP will be less from an in situ opertion than from a surface retorting process. There will also be an advantageous plume rise gained from the greater volume and heat of exhaust gases from the in situ operation. Greater plume rise can be substituted for stack height.

Air Quality will be affected by the addition of dust, hydrocarbons, carbon monoxide, sulfur dioxide and nitrogen oxides as a result of construction activiites, plant operations, and increased population in near by communities.

Due to the relatively small scale of development activities taking place during the Ancillary Phase, there will be little change in the existing quality of air in the Piceance Basin.

Emission controls for the following pollutants are listed on Table 2.1-1 of the July 21, 1977, Air Quality Control Plan, which is included on the following page.

* Sulfur Dioxide - SO_2 will be emitted from the combusion processes.
* Nitrogen Oxides - NO_x will also be emitted from the combustion processes.

ESTIMATED EMISSIONS INVENTORY DURING SHAFT - SINKING AND ANCILLARY DEVELOPMENT PHASES

PHASE	SOURCE OR ACTIVITY	MATERIAL HANDLING RATE	POLLUTANT	EMISSION FACTOR W/O CONTROL		EMISSIONS W/O CONTROL (lb/hr)	CONTROL MEASURE: DEVICE	CONTROL MEASURE: EFFICIENCY (%)	EMISSIONS WITH CONTROL (lb/hr)	EMISSIONS WITH CONTROL: ppm (1)	STACK CHARACTERISTICS: NUMBER	HEIGHT (m)	DIAM. (m)	VOL. FLOW (SCFM)	EXIT TEMP. (°F)
SITE PREPARATION & SHAFT SINKING	Access Road	4.2 mi; 20 mph; 3049 veh. mi	Fugitive Dust	0.27 $(1.068)^V$ - 1.54 where V: veh speed (mph)	(b)	363001b/hr	Pave Road	100	0						
	Temporary Power Generation	10,000 HP	Particulates SO_2 NO_2	36.7 lb/day (0.02%S) 12.2 lb/day 513 lb/day	(a)	1.5 0.5 21.4	Unmanifolded - No Control	0 0 0	1.5 0.5 21.4		10	4	0.5		
	Site Preparation	14 acres Disturbed (25% Exposed)	Dust	1.4 tons/ac/mo	(a)	13.6	Chemical Stabilizers	80	2.7						
	Mine Shaft Shale Transfer Pts.	9400 tons/day	Dust	0.1 lb/ton	(d)	39.2	Wet Suppression	75	9.8						
	Surface Transfers via Diesel Equipment	Total Surface Diesel - 4000 gal/day 9400 tons shale/day 400 veh mi/day - shale tr.	Particulates SO_2 CO THC NO_x Fugitive Dust	13 lb/1000 gal (0.02%S) 2.7 lb/1000 gal 225 lb/1000 gal 37 lb/1000 gal 370 lb/1000 gal 1000 lb/day	(a) (b)	2.2 0.5 37.5 6.2 61.7 41.7	 Catalytic Converter " " Chemical Stabilizers	0 0 90 90 0 80	2.2 0.5 3.8 0.6 61.7 8.3						
	Shale Crushing	9400 tons/day	Dust	0.5 lb/ton	(c)	195.8	Baghouse	99	2.0		1	10	0.6	20000	Ambient
	Shale Disposal	9400 tons/day - 80 acres max.	Dust	8 tons/ac/yr	(b)	146.0	Chemical Stabilizers	80	29.2						
ANCILLARY DEVELOPMENT PHASE	Equipment - (Total Including Mining, Blasting, Handling & Hauling, Crushing, and Rubbling)	≤ 1 blast/shift; ≤ 70 times/year Diesel 7000 gal/day; 41000 tons shale/day	Part. 24 hr Annual SO_2 - 3 hr - 24 hr Annual CO - 1 hr 8 hr Annual THC - 3 hr Annual NO_x - Annual	See Table 2.1-2 for Emission sub-totals by activity and Table 2.1-3 for Emission Factors		1600 1500 45 7 2 300	Baghouse Baghouse Diesel Equipment has Catalytic Converters for CO, HC	99 99 0 0 0 90 90 90 90 90 0	16 15 45 7 2 19140 2450 257 59 12 300	5.5 5.1 7.0 1.1 0.3 6281 869 91 2.9 0.6 64.8	1	88	3.3	636,534	>3° Above Ambient
	In-Situ Gas Treatment	10% full Scale - assumed in modeling 81.9 BTU/SCF (HHV)	Particulates SO_2 CO THC NO_x	1.17 lb/10^6 ft^3 1500 ppm H2S equiv. 1.33 lb/10^6 ft^3 0.234 lb/10^6 ft^3 9.30 lb/10^6 ft^3	(a) (a)	7.4 1500 ppmH2S 8.4 1.5 59	Stretford Unit followed by Thermal Oxidizer	0 99 0 0 0	7.4 17.4 8.4 1.5 59	6.5 7.2 7.9 0.2 33.6	1	25	4	240,000	400
	Steam Generator - (Boiler)	620 bbl/day fuel oil, 100,000 lb/day boiler	Particulates SO_2 CO THC NO_x	0.023% Sulfur Fuel Oil; Non-Sulfur estimates from burning fuel oil	(a)	16.3 3.6 4.3 3.3 87	No Emission Controls	0 0 0 0 0	16.3 3.6 4.3 3.3 87	114.3 11.8 32.3 3.5 397.	1	52	1.6	30,070	400
	Fuel Tank Storage	3.99 x 10^6 gal/5 days 101 Full Scale Handling	THC (Fugitive)	Storage Loss: 0.0052 lb/dy per 1000 gal (a) Work Loss: 1 lb/gal			Floating Roof Tanks		11						
	Mine Shaft - Conveyor Transfer Pt.	41000 tons/day	Dust	0.1 lb/ton	(d)	170.0	Wet Scrubber	99	1.7		1	10	1.2	80,000	Ambient
	Shale Conveyor	41000 tons/day	Dust	0.03 lb/ton	(d)	51.3	Continuous Wet Suppression and Chemical Addit.	85	7.7						
	Shale Disposal	41000 ton/day; 80 ac. max.	Dust	8 tons/ac/yr	(b)	146	Chemical Stabilizers	80	29.2						

(a) EPA AP-42 (b) [illegible]co Rept #9 (c) Marshall and Agapito, Colony App 14 (d) Assumption

(1) ppmv except for particulates which are ppmw

* Particulates - will be emitted from the mine through the off gas stack, steam generator and mine exhaust shaft.
* Hydrocarbons - are produced by retort combustion and operation of boilers, gas processing equipment, diesel engines, emergency flares, and off vapors from storage tanks.
* Fugitive Dust - mining, hauling, dumping and conveying of raw oil shale will produce fugitive dust.
* Water Vapor - from exhaust gas stream, blowdown, evaporation ponds, and irrigation increase the fog potential occurrence and severity of icy conditions in the winter.
* Odor - some odor from the shale oil and during upset conditions may occur.
* Flaring - flares will be used during startups and upset conditions.

b. Issues/Needs

(i) Ancillary phase air quality model including explanation of worst case meteorological conditions used in the model, emission source points (stack parameters, locations and plume buoyancy), retort off gas composition, and

pollution control plans (methods) and their expected efficiencies.

(ii) Verification that Table V-A in the Modifications includes emissions from all significant sources (example: steam boilers, waste heat boilers, thermal oxidizers, reforming units, dust sources, etc.).

(iii) Nature of sulfur compounds in treatment tail gases (example: COS, RSH, etc.).

(iv) No_x emission levels relative to higher in situ retort temperatures.

(v) Procedure for handling latent gas generated by shut in retorts under normal and emergency conditions.

(vi) Justification of the validity of the TOSCO II model (November 1, 1976) for predicting emission levels during full scale operation.

(vii) Excess design capacity for air pollution control systems.

(viii) Nature of hazardous emissions such as mercury, arsenic, and arsine.

c. Resolution of Issues

(i) The lessee submitted, on 6/10/77, an ancillary phase emission model which demonstrated that all applicable air quality regulations both

State and Federal, could be met using best, practicable commercially, available equipment and techniques, and realistic stack parameters. Worst case meteorological conditions, as defined by baseline environmental studies, and normal operating parameters were used in deriving vectored model emission estimates.

On 6/28/77, the lessee submitted a simplified Air Pollution Control Plan, which together with other letters submitted in April and in early July 1977, regarding emission of specific constituents, upset conditions, and plume rise constituted a reasonable set of control subject to the below stated conditions.

Then on July 21, 1977, the lessee submitted a comprehensive "Air Quality Control Plan for Tract C-b", incorporating all of the above listed submissions into a coherent plan for Ancillary Phase operations. This plan lists specific stack parameters and flow volumes, all source emissions with and without controls, control methods, and their expected efficiencies. These factors are summarized in Table 2.1-1, on the preceeding page.

(ii) In response to direct question, the lessee stated that Table V-A, as revised and submitted by letter of 4/11/77, includes emissions estimates from all significant sources for full-scale operation.

(iii) Evaluation of confidential submissions of emission data from Oxy's, D.A. retort #4, and correspondence of 4/7/77 from ERDA, suggests that emission of organic sulfur compounds, such as COS, are so low that specific off gas treatment systems, other than Stretford or similar treatment, followed by thermal oxidation to control hydrocarbon and inorganic sulfur compound emssion, are unnecessary. The lessee, however, has not previously undertaken a study of treatment tail gas composition other than for constituents covered by applicable air quality standards. The lessee has indicated their intention to initiate such a study which will be made manditory by conditions for approval.

(iv) Under the original DDP scheme, 1,995 lb/hr of NO_x would have been generated largely by the pyrolysis preheater that operates at high temperatures under oxidizing conditons. In

situ retorting will produce only 588 lb/hr NO_x in the retort off gas streams and an additional 300 lb/hr of NO_x in the mine ventilation exhaust largely from the operation of diesel powered equipment underground, or a total of 888 lb/hr. The low NO_x volume in the retort off gases is due to the lower internal combustion temperature compared with surface retort preheaters and that in situ retorts are operated under oxygen deficient conditions. Most of the NO_x in the Oxy process would be derived from subsequent surface combustion of low BTU off gas for steam and power generation.

(v) Latent gas and shale oil produced by shut in retorts during either normal or emergency conditons would continue to flow into the connected production-gas levels. Gases would be swept through the gas level and up the gas shaft by surface blowers and treated along with off gas from active retorts. Similarly, shale oil would continue to gravity drain along the isolated sections of the production level to collection sumps and from there be pumped to the surface along with oil from

active retorts. These procedures would continue for the life of the project. Ultimate retort confinement would follow a number of alternative procedures. As conditioned in Part 5.0, Processing, the lessee will have to provide definitive abandonment plans prior to commencing commercial development.

(vi) By letter of 6/16/77, the lessee sought to establish the validity of the TOSCO II modeling for predicting compliance with air quality standards on the basis of plume rise under mean wind speed conditons of 15 meters per second. Under such conditions, plume rise from process units in the original DDP would range from 96 to 107 meters, whereas plume rise from in situ processing will range upward from 298 meters. The higher plume rise is due to higher off gas temperatures and volume. Mine vent plume rise is also comparably higher, but of little consequence as it carries less than 4% of the total SO_2 emitted by the gas treatment plant over 24 hour averaging periods. The argument for model validity is thus based on lower initial pollutant concentrations than envisioned in

the original DDP development scheme and greater plume rise which will enhance dispersion.

(vii) The lessee has stated that all pollution control systems will conform to the industry rule of thumb.

(viii) By letter of 4/1/77, the lessee indicated that potentially hazardous emissions would be limited to H_2S, arsenic and arsine. Hydrogen sulfide will be stripped from the retort off gas to less than 15 ppmv in the Stretford or similar units. The residual will be converted to SO_2 when the off gas is burned for steam or power generation or in follow-on thermal oxidizers.

It is known that arsenic preferentially accumulates in asphalts and other heavy ends of the product oil. Light fractions and off gases will contain less than 2 ppm arsenic by weight. Completing the necessary dilution calculations for comparability with Colorado Air Quality Control Regulation 8, indicates that allowable emission rates for arsenic and arsine are 19.5 ppm and 7.9 ppm, respectively.

Comparing these with expected emission rates indicates that 35 times more arsenic and 15 times more arsine could be emitted without statutory violation.

Similarly, mercury emissions, as reported in the lessee's letter of 6/28/77, are calculated as being one half the allowable level if all the mercury were in the form of alkyl compounds and one tenth statutory maxiumum if none of the mercury appeared as alkyl compounds.

d. Recommendations

That all applicable sections of the original DDP, Modifications, and supplemental material, listed below, relating to air pollution control be approved subject to the below conditions:

Original DDP: Control Plan V-A; Air Quality Control Plan (as revised) of 11/1/76.

Modification: Control Plan V-A.

Supplemental: Letter of 4/11/77 re., revised table V-A; letter of 4/1/77 re., upset conditions and hazardous substances; letter of 4/15/77 re., No_x emissions;

memorandum of 5/19/77 re., mercury emissions; Ancillary Phase Emission Model of 6/10/77; letter of 6/16/77 re., plume rise; and letter of 7/21/77 re., Air Quality Control Plan for Tract C-b.

e. Conditions

(i) The lessee shall incorporate the best practicable commercially available environmental (pollution control) technology in all phases of ancillary and commercial development.

(ii) The lessee, prior to commercial phase development, shall submit a detailed evaluation of ancillary retort off gas composition from retorts on Tract C-b.

(iii) The lessee shall submit a detailed emission model and air quality control plans, including stack parameters, for and prior to the commercial phase development.

f. Monitoring

Monitoring on the following parameters shall be considered and carried out at intervals determined appropriate during finalization of the development monitoring program:

Hydrocarbons, sulfur compounds and particulates in mine ventilation exhaust;

Dust levels at selected dump, conveyor transfer stations, haul road stations;

Ammonia;

Carbonyl sulfide (COS);

Toxic trace elements;

PNA;

Stibine; and

Arsine.

11. Part 8.2, Water Pollution Control

a. Basic Plan

Spent in situ retorts can be kept from serving as sources of water pollution by 1) deliberate leaching, with retrievaland evaporative concentration of the leachate, 2) diversion of ground water from the area,and 3) isolation of the retorts. The Erosion Control and Surface Rehabilitation Plan (6/17/77) will be implemented to minimize erosion and surface water pollution. The dams across Sorghum Gulch and Cottonwood Gulch will act as final catchment and settling basins for the major construction,plant sites, and raw shale embankments. Fuel and chemical storage areas will be diked in accordance with Lease stipulations. Sewage will be treated. Excess mine water will be disposed of by irrigation, reinjection, treatment and release to Piceance Creek, or some combination thereof. Supplemental material to the Modifications contains a program for field and laboratory analysis of shale leachability.

b. Issues/Needs

(i) A detailed description of the mine and surface water handling facilities, including degree of treatment, dam and impoundment storage, disposal methods, surface drainage diversion, contingency for excess flow, and procedures to minimize groundwater contamination.

(ii) Probable water pollution controls to be implemented as part of abandonment and reclamation procedures.

(iii) Specifications to accommodate 100 year flood flow.

(iv) Effects of groundwater back flooding of retired retort chambers on groundwater quality and strength of rubbled, retorted shale.

(v) Leachability of raw shale that will be deposited on the surface.

(vi) Augmentation plans to offset possible loss of surface flow in which there are vested interests.

(vii) Mine dewatering rates.

(viii) Effects of project on the salinity in Colorado River Basin.

c. Resolution of Issues

(i) The issues will be resolved pursuant to condition of approval;below.

The lessees have also submitted supplemental data on water handling by letter of June 15, 1977, in response to the issues; and a water management discussion by memo of June 28, 1977.

(ii) The issue will be resolved pursuant to condition of approval, below.

Lessee submitted a preliminary Abandonment Plan by letter of June 15, 1977. An Erosion Control and Rehabilitation Plan was also submitted on June 28, 1977, detailing in part final reclamation procedures.

(iii) Lessee reply of June 15, 1977, indicates the lessee is aware of the lease stipulation regarding the 100 year flood, and that the latest technology will be used when dams and impoundments are designed and built.

(iv) Issue will ultimately be resolved pursuant to condition of approval, below.

Lessee responded to this issue by letter of June 15, 1977, and has submitted a proposed shale leaching investigation study by memo of July 1, 1977. Ward Smith (ERDA) provided additional information with respect to this issue on May 26, 1977. The Bureau of Mines (DMRC) is currently investigating structural and load bearing strength of samples of in situ retorted shale.

(v) Issue will be resolved pursuant to condition of approval, below.

By response of June 15, 1977, the lessee indicates they have conducted no testing to date on the leachability of raw shale. However, by letter of 6/17/77 and 7/1/77 the lessee has outlined a suitable field and laboratory investigation of raw shale leachability.

(vi) The lessee is preparing a water augmentation plan for submission to the Colorado Water Court on or about July 15, 1977. The Area Oil Shale Office will obtain a copy of this plan under condition of approval, below.

(vii) Dewatering rates are detailed in lessee reply of June 15, 1977, and a letter from Tipton and Kalmback, Inc. on May 17, 1977. Over the first six years of operation, mine inflow will increase to 3,800 to 9,550 gpm and level off shortly thereafter at about 10,500 gpm for the remainder of tract operation.

(viii) Salinity issue addressed in lessee response to State of Colorado on June 15, 1977. Increase would be less than .12 mg/1, which is below limits of accuracy for measurement at Hoover Dam.

d. Recommendations

That all sections of the original DDP, Modifications, and supplemental material, listed below, be approved subject to the below conditions and consideration of the stated monitoring objectives at the time the development monitoring program is revised:

Original DDP: Control Plan III-M-2, IV-E-9, and V-B; Tankage IV-E-10.

Modifications: Impoundments III-D-6, III-E-7; Control Plan III-D-6 & 7, III-E-8, and V-B; Tankage III-E-4.

Supplemental: Field Leaching Study of 6/17/77, letter of 6/28/77 re., water management and erosion control; letter of 7/1/77 re., laboratory leaching investigation.

e. Conditions

(i) The plan for dams and impoundments contained in the DDP shall be supplemented by a water management plan that shall be submitted to the Mining Supervisor for approval prior to construction activities. The plan shall include a hydrologic monitoring program during shaft sinking and a description of surface water handling facilities, dams, impoundments, seepage control, treatment facilities, and groundwater control in the vicinity of the in situ retorts during the ancillary and commercial phases of development. The plan will contain a contingency plan for excess flow. A copy of the required flow augmentation plan under Colorado water law

shall be filed with the Area Oil Shale Office.

(ii) The lessee shall initiate a program and submit, prior to commercial phase operations, a report on the mineralogy and leachability of raw and in situ processed shale on Tract C-b. The program will emphasize the solubility and mobility of tract and toxic constituents and the effects of leaching on the load bearing strength of the rubble filled retort chambers.

(iii) The abandonment plan contained in the DDP shall be supplemented to provide greater detail on retort retirement and stabilization. The amended plan shall be submitted to the Mining Supervisor for approval prior to commercial phase retort development. The plan shall emphasize stabilization of in situ retorts, control of leaching from raw and processed shale, and reclamation practices for surface areas used for evaporation of waste waters, if any.

f. Monitoring

A control site needs to be established to monitor surface flow, which will not be affected by mine dewatering and a decline in the ground-water levels.

Monitoring program needed for leachates and tract elements from the in situ retorts and raw shale disposal pile.

Some monitoring needed on the subsidence effects on the groundwater regime.

12. Part 8.3, Oil Spill Contingency Plan

a. Basic Plan

The original DDP describes a spill contingency plan for above ground activities suitable for the modified plan. Oil produced underground in the modified in situ process is confined in strategically located sumps from which it is piped to the surface. The spill contingency plan for the product pipeline would be prepared upon completion of the final selection of the corridor route. The contingency plan will be implemented by a spill response team under direction of a Spill Response Coordinator, who will immediately notify the Mining Supervisor and other government agencies. Procedures for prevention, detection, confinement, cleanup, and disposal procedures are outlined in the original DDP for in plant spills, staging area spills, and trucking spills. Bulkhead failures in the mine would inundate only limited sections of the production level while the shale oil gravity drains down dip to the next collection sump or to the main mine water collection basin near the 15' diameter shaft. Spread of escaping off gases would be limited by flow of exhaust air into the underlying gas level, which is always maintained at negative pressure by exhaust fans in the gas shaft.

b. Issues

None

c. Resolution of Issues

None

d. Recommendation

Approve all below listed sections of the original DDP, Modifications, and supplementary material pertaining to spill contingency planning.

Original DDP:	Contingency Plan V-L
Modifications:	Contingency Plan V-L
Supplemental:	Letter of 6/28/77 re., retort liquid handling

13. Part 8.4, Fire Prevention and Control

a. Basic Plan

The original DDP describes fire prevention and control plans for construction, mine operations, and above-ground operations. It will be the responsibility of a Fire Control Coordinator to direct manpower and emergency equipment in all fire-fighting activities on the tract. The control plan during construction addresses explosives and blasting, welding, spark arresters, lunch and warming fires, smoking, gas powered equipment, storage and parking areas, burning areas, and flammable liquids. During operations, trained crews and emergency equipment will be on a 24 hour standby at established fire control facilities on the surface and in the mine. Sources for underground fire include fuels and lubricants, equipment, explosives, mine supplies and trash. The modified plan addresses in situ retort control and confinement. The retorts will be operated under negative pressure relative to occupied mine areas to prevent escape of combustable gases. All personnel will be trained in escape and fire fighting procedures.

b. Issues

(i) Regulation of air to retorts.

(ii) Procedures to constantly maintain retorts under negative pressure to off set steam injection pressure and back pressure buildup following emergency or planned retort shut down.

c. Resolution of Issues

(i) Response of June 17, 1977, describes manual and electrical valve regulators at the top of each retort to control air inflow. These valves can be closed within minutes to slow down or eventually shut off a retort, or to immediately prevent escape of combustible gas.

(ii) Response of June 17, 1977, indicates there is an immediate pressure drop as the steam expands into the retort chamber, and that retort connection at the bottom to the production-gas levels assures a constant 4 psi pressure drop throughout the height of the retort column. This connection will always be maintained, although the top of the retort may be shut in. Any latent gases generated will bleed into the active collection stream and be processed through the gas treatment stream.

d. Recommendation

Approve all sections of the original DDP and Modifications, listed below, that pertain to fire control:

Original DDP: Control Plan V-E

Modifications: Control Plan V-E, and III-E-2 and 6.

14. Part 8.5, Disposal of Other Wastes

a. Basic Plan

The disposal of solid and liquid wastes will be handled as proposed in the original DDP. It is anticipated that much of the waste will be disposed of with the raw shale. Construction materials will be gathered and buried at the shale disposal site. Waste streams from the water treatment facilities and sewage treatment facilities will be disposed of at the shale disposal site. The raw shale disposal site will also be used as a sanitary landfill. Liquid waste streams will be used for moisturization of shale. Liquid petroleum wastes will be collected, stored in approved containers, and transferred to a waste petroleum dealer.

b. Issues

(i) The DDP presents conceptual plans for disposal of potentially toxic wastes, but no design plans.

(ii) The lessee confirms that the raw shale embankment will be used as a disposal site for process and domestic wastes, but the method of disposal is not presented.

c. Resolution of Issues

(i) Issue will be resolved pursuant to condition of approval, below.

(ii) Issue will be resolved pursuant to condition of approval, below.

d. Recommendations

That all aspects of the original DDP and Modifications pertaining to disposal of wastes, listed below, be approved subject to the below stated conditions and suggested monitoring:

Original DDP: Disposal Plan V-I

Modifications: Disposal Plan V-I, III-D-8, III-E-9

e. Conditions

(i) In recognition of the available options presented in the DDP, the lessee shall prior to disposal of any potentially toxic wastes, including, but not limited to, sewage sludge, garbage, mineral salts, and other industrial wastes, submit a final plan to the Mining Supervisor for approval. The disposal plan will emphasize reclamation or recycling wherever possible.

(ii) The lessee shall submit specific details for the disposal of solid or liquid wastes with raw shale.

f. Monitoring

Areas utilized for waste disposal should be monitored for leachates and trace elements, and for accidental contact with fauna.

15. Parts 8.6 and 8.7

PROTECTION OF HISTORIC, SCIENTIFIC, AND AESTHETIC VALUES

a. Basic Plan

The original DDP describes the plan for protection of objects of historic, scientific, or aesthetic value. Areas have and will be evaluated prior to site disturbance, qualified personnel will evaluate finds during operations and the AOSS will be notified of any discoveries. Procedures to minimize aestheitc impacts will include placement and shaping of materials with respect to existing terrain, surface preparation for revegetation, vegetative cover, landscape blending, slope rounding, conserving existing vegetation, preservation of natural areas, and designing and painting structures to blend into surroundings.

b. Issues

(i) Certification from the surface managing agency that the proposed action is in compliance with the National Historic Preservation Act.

(ii) Concern that observations for buried objects will be made during construction operations.

(iii) Specific details for surface shaping of the raw shale disposal piles are not presented.

c. Resolution of Issues

(i) Response of June 18, 1976, from BLM State Director recommends a determination of "No Effect".

Response of June 28, 1976 from State Historic Preservation Officer concurs with a determination of "No Effect".

Response of July 14, 1976 from the National Advisory Council acknowledges the determination of "No Effect."

(ii) Issue will be resolved pursuant to condition of approval, below.

(iii) Issue will be resolved pursuant to condition of approval,below.

In addition, the raw shale handling plan (6/28/77) describes the methods by which the shale will be deposited and shaped. The end result will be a rolling upland topography with back terraced out slopes drained by non eroding culverts into permanent sediment settling basins with upstream diversion structures to carry natural runoff and stream flow around waste disposal sites.

d. Recommendations

That all sections pertaining to protection of historic, scientific, and aesthetic values, listed below, be approved subject to the below conditons:

Original DDP: Protection Plan V-D

Modifications: Protection Plan V-D

e. Condition

(i) The lessee shall maintain a program of

continuing observation for items of historic, prehistoric, or scientific value during construction and tract operations. Reporting of uncovered objects shall be in compliance with Section 6 of the Oil Shale Lease Environmental Stipulations.

(ii) The lessee shall supplement the raw shale disposal plans in the DDP by submitting a final description of the raw shale disposal and surface contouring to the Mining Supervisor for approval prior to surface deposition.

16. Part 8.8, Noise and Vibration Control

a. Basic Plan

The control plan in the original DDP is applicable. Noise and vibration levels from the large blasts used to form the in situ rubble columns will not present problems at the surface. Blast noise and ground motion will be barely noticable beyond 400 yards. The lessee will protect employees by compliance with the noise standards of EPA, MESA, OSHA, and State of Colorado. A noise control program will include continuing noise exposure evaluation and regular examinations. In some cases, personal protection in the form of ear plugs, ear muffs, and soundproof cabs may be necessary. Noise levels will be periodically monitored during construction and operation activities to insure that standards are met.

b. Issues

(i) Quantification of surface noise and ground vibration associated with underground blasting, movement of surface equipment, mine intake and exhaust fans, and operation of steam generation and compressor facilities, and the effect of this noise and vibration on people and wildlife.

c. Resolution of Issues

(i) Response of June 15, 1977, from the lessees presents noise and vibration data from the

Oxy DA site. Expected particle velocity from an underground blast will not affect building structures or cause surface rock damage outside the tract boundary. Effects on people and wildlife on the surface should be insignificant.

d. Recommendations

That all sections, listed below, pertaining to noise control be approved subject to the below suggested monitoring:

Original DDP: Control Plan V-C

Modifications: Control Plan V-C

e. Monitoring

Noise monitoring at specific locations during construction and development, every two months or each quarter including notation of effects on people and wildlife.

17. Part 8.9, Fish and Wildlife Management

a. Basic Plan

The original DDP is referenced for the plans for fish and wildlife habitat management. An Environmental Field Coordinator will supervise the activities covered in the plan. The general strategy of the plan involves revegetation of disturbed areas, habitat improvement, and the installation of underpasses and deer-proof fences where deer would be exposed to hazardous vehicular movement , or impoundments of polluted water. Specific problem areas which are addressed in the plan include modification of terrestrial habitats, modification of aquatic habitats, erosion and siltation affecting aquatic habitats, water pollution affecting aquatic habitats, reduction in groundwater discharge to terrestrial and aquatic habitats, wildlife disturbance due to human activity, effects of air pollution, effects of noise, vehicle-wildlife collisions, management of water reservoirs, secondary effects resulting from growth, personnel management, and access management.

b. Issues

Concern that the original fish and wildlife plan is inadequate.

c. Resolution of Issues

The lessee submitted a revised Fish and Wildlife (habitat) Management Plan on June 17, 1977. The revised

plan was developed in cooperation with the State Division of Wildlife, BLM, Area Oil Shale Office, and in accordance with the Regional Piceance Basin Habitat Management Plan. The plan addresses habitat conversion, restoration, and public access.

d. Recommendation

That all sections of the original DDP, Modifications, and supplemental material listed below pertaining to fish and wildlife management be approved:

Original DDP:	Management Plan V-J
Modifications:	Management Plan V-J
Supplemental:	Fish and Wildlife Management Plan of 6/28/77.

18. Part 8.10.1 Overburden Management

a. Basic Plan

The original DDP describes overburden management procedures. After an area is cleared and grubbed, the topsoil will be removed and stockpiled or placed on areas ready for revegetation. Stockpiled material will be benched, watered and revegetated, until it can be used.

b. Issues

None

c. Recommendation

That all sections, listed below that pertain to overburden management be approved:

Original DDP: Plan V-G

Modifications: Plan V-G

19. Part 8.10.2, Raw Shale Handling

(Also see EROSION CONTROL & SURFACE REHABILITATION PLAN

a. Basic Plan

The modified plan and supplemental material describe raw shale storage in Cottonwood and Sorghum Gulch and discusses several alternatives for disposal during later years of the project. The raw shale embankment will be developed in relatively small sections that are brought to full height and vegetated as soon as possible. A raw shale revegetation plot will be utilized to develop and demonstrate the most practical method for revegetating raw shale. A preliminary time table for revegetation is presented in the Modifications and in the subsequently submitted Erosion Control and Rehabilitation Plan of 6/17/77.

b. Issues

(i) Further explanation is needed regarding shaping, grading and surface contouring of raw shale piles.

(ii) Techniques should continually be evaluated throughout the life of the project for underground disposal of raw shale.

(iii) The feasibility of surface retorting of the mined shale should be evaluated as well as the practicality of backfilling the mine with processed shale.

c. Resolution of Issues

(i) Lessees submitted a supplemental raw shale disposal plan on June 28, 1977. This plan discusses raw shale properties, production quantities, site selection, disposal procedures, water diversion and control, stabilization, and rehabilitation. The raw shale disposal system description includes a discussion of raw shale receiving and surge storage, raw shale conveying to Cottonwood and Sorghum Gulch, shale spreading, dust collection and suppression equipment, and placement timing.

(ii) & (iii)

These issues will be resolved pursuant to condition of approval, below.

d. Recommendation

Approve all sections of the original DDP, Modifications, and supplemental material, listed below, pertaining to raw shale handling, subject to the below stated condition:

Original DDP: Control Plan V-H

Modifications: Control Plan V-H

Supplemental: Letter of 6/28/77 re., Raw Shale Handling

e. Condition

The lessee shall supplement the raw shale storage plans in the DDP by submitting a final description of the

raw shale disposal sequence, grading, and surface contouring to the Mining Supervisor for approval prior to surface disposal. The lessee shall continue to evaluate techniques for underground disposal of mined shale and/or the feasibility of surface retorting.

20. Part 8.10.3, Erosion Control and Rehabilitation

a. Basic Plan

The original DDP presented specific methods for controlling erosion and rehabilitating the land surface. Surface erosion control options are discussed for cuts and fills, runoff control, temporary slope protection, limiting exposed surfaces, and wind erosion control. Stream flow control options are discussed for sedimentation, flow concentration, energy dissipation, stream crossings, and channel modifications. The revegetation of disturbed areas considers seed selection, fertilizer, mulch selection, seed bed preparation, seeding and mulching operations, planting time, irrigation, invasions, fertility testing, existing vegetation, and evaluation and followup. Revegetation of processed shale is not considered as part of the Modifcations. A revised Erosion control and Revegetation Plan was submitted on 6/17/77 outlining a program to develop and demonstrate methods for raw shale revegetation.

b. Issues

(i) Reclamation costs are not provided in the DDP.

(ii) Further explanation is needed regarding shaping, grading and surface contouring of raw shale piles.

(iii) Fencing should be considered to aid revegetation success.

(iv) A reclamation time schedule is needed.

(v) Reclamation procedures are needed should early tract abandonment become necessary.

(vi) Special reclamation procedures for settling and evaporation basins.

c. Resolution of Issues

(i) Lessee response of June 15, 1977, indicates that detailed accounting procedures will be implemented to keep tract of environmental costs.

(ii) Lessee submitted a revised Erosion Control and Rehabilitation Plan on June 17, 1977. The plan provides an estimate of disturbed areas, and a revegetation plan for the raw shale disposal pile. A demonstration plot is planned. Issue will be resolved pursuant to condition of approval, below.

(iii) The lessee indicates by reply of June 15, 1977 that they are committed to fencing only as it proves necessary.

(iv) Lessee submitted a revised Erosion Control and Rehabilitation Plan on June 17, 1977 which includes a reclamation time schedule

limiting unreclaimed raw shale embankment area to less than 100 acres.

(v) Lessee provided an Abandonment Plan by letter of June 28, 1977. The issue will ultimately be resolved pursuant to condition of approval, below.

(vi) Issue will be resolved by condition of approval, below.

d. Recommendation

That all sections of the original DDP, Modifications, and supplemental material pertaining to Erosion Control and Rehabilitation, listed below, be approved subject to below stated conditions:

Original DDP: Control Plan V-K

Modifications: Control Plan V-K, I-E-5, Table I-B

Supplemental Material: letter of 6/17/77, re., revised Erosion Control and Rehabilitation Plan.

e. Condition

(i) The lessee shall supplement the Erosion Control and Rehabilitation Plan of the DDP by submitting a final description of the raw shale shaping, grading, and surface contouring

to the Mining Supervisor for approval prior to surface disposal.

(ii) The Abandonment Plan contained in the DDP shall be supplemented and submitted to the Mining Supervisor for approval prior to commercial phase retort development. The plan shall include reclamation practices for surface areas used for evaporation of waste waters, if any.

21. Part 8.11, Health and Safety

a. Basic Plan

The original DDP contains plans for health and safety programs on the tract. These health and safety procedures include a comprehensive safety program and medical surveillance program. Possible health hazards include dust, carcinogens, noise, explosives handling and storage, mine explosions, roof falls, and unexpected occurrences. Safety hazards of concern are electrical equipment, conveyor belts, high temperature equipment, maintenance shop areas, and manual equipment. Two other considerations discussed in the modified plan are stability of the mine and subsidence. By letter of June 28, 1977, the lessee further amended the H & S program in the Modifications with specific safety procedures and employee hygiene adopted by Oxy.

b. Issues

(i) Plan to control public access to potentially hazardous areas.

(ii) Quantification of surface noise and vibration from operations.

(iii) Employee exposure to carcinogens.

c. Resolution of Issues

(i) Response of June 15, 1977, states that the lessee will fence and have guards to prevent public access to hazardous areas. Other

areas will be accessible to the general public in accordance with terms of the lease.

(ii) Response of June 15, 1977, presents noise and vibration data from the DA site. Expected particle velocity from an underground blast will not affect building structures or cause surface rock damage. Effects on people and wildlife on the surface should be insignificant.

(iii) Response of June 28, 1977, provided additional information on employee hygiene.

d. Recommendation

That all sections of the original DDP, Modifications, and supplemental material, listed below, be approved:

Original DDP:	Control Plan V-F
Modifications:	Control Plan V-F
Supplemental:	Letter of 6/28/77 re., Safety and Health Programs

22. Part 9.0, Environmental Impacts

a. Basic Plan

All related impacts are discussed appropriate to their mitigation in preceeding parts of the evaluation. As unforeseen impacts arise and are quantified by the Development Monitoring Program, appropriate mitigative measures will be worked out and implemented under the Mining Supervisor's authority to modify the approved plan.

b. Issues

(i) Quantification of surface noise.

(ii) Effects of subsidence on surface areas.

c. Resolution of Issues

(i) Noise is discussed in Part 8.8 of this review.

(ii) By letter of 6/28/77, the lessee outlined a program to evaluate stability of mine openings and subsidence using a routine program of monitoring and observation.

d. Recommendations

That all aspects of the Plan Modifications be approved subject to revision of the Development Monitoring Program, prior to lateral mine development as per Lease stipulation 1(c) (1).

e. Monitoring

The lessee shall carry out a routine program of visual assessment of subsidence effects on structures associated

with tract development with emphasis on the integrity of dams, shafts, mine workings, and raw shale embankments. Precision surveys shall be run at routine intervals to quantity the magnitude of surface movement.

23. Part 10.0, Monitoring

a. Basic Plan

The Development Monitoring Program was revised subsequent to submission of the original DDP and resubmitted as a supplement thereto on October 1, 1976. The supplemental plan was determined to be approvable by the Mining Supervisor. This plan will be reviewed and revised as necessary after the lessee completes submission of the Final Environmental Baseline Report (Appendix F).

b. Issue

Specific items for consideration for inclusion in the monitoring plan have been identified in preceeding parts of this review.

c. Recommendations

That the plan of October 1, 1976, be implemented prior to commencement of any development and that no lateral mine development be permitted until the below condition has been fulfilled and any needed revisions to the monitoring plan implemented.

d. Conditions

The lessee shall review and revise the Monitoring Plan of October 1, 1976, based on analysis of the Final Baseline Data Report and in light of changed development technology and land use requirements of the modified plan, and shall submit the revised monitoring program for approval

prior to commencement of lateral mine development. Until such time, the October 1, 1976, shall be implemented prior to commencement of any development activities on tract.

24. Part 11.0, Alternatives

a. Basic Plan

Alternative stated in the DDP Modification include:

Surface retorting of mined shale;

On site power generation from low Btu retort off gas; and

Alternative water supply and management.

b. Issues

(i) Continues evaluation of economic feasibility of surface retorting of mined shale.

(ii) Beneficial use of retort off gas.

(iii) Overall water management plan.

c. Resolution of Issues

(i) The lessee has indicated that continued evaluation of the economic feasibility of surface retorting shall be carried out. Condition of approval, below, will make it mandatory that one such evaluation shall be carried out and reported to the Mining Supervisor prior to any surface deposition of mined shale.

(ii) The lessee has indicated his intention to make full and practicable economic use of retort off gas or components thereof. Off gas will be used for steam generation.

(iii) The complexities of water use and rights acquisition make it impracticable for the lessee to discuss alternatives for supply and management until the water court approves an augmentation plan. Conditions of approval, below, will make it mandatory that realistic flow augmentation alternatives be developed prior to construction activities, and a copy submitted to the Mining Supervisor.

d. Recommendations

That sections I-E-4 and IV-A-D of the plan Modifications be approved subject to the below conditions:

e. Conditions

(i) Prior to surface disposal of mined shale, the lessee shall submit a final description of the raw shale disposal sequence which shall include a current evaluation of the feasibility of surface retorting.

(ii) Prior to any construction activities, the lessee shall submit an overall water management plan which shall include a surface flow augmentation plan required by Colorado water law.

25. Part 12.0, Capitalization

a. Basic Plan

Capital investments totalling $442,609,000 will be required to bring the tract to commercial operation as described in the plan Modifications:

Mining	$136,696,000
Oil & Gas Process	103,038,000
General Facilities	483,982,000
Contractor, Engineering, Fees, Contingencies	118,893,000
TOTAL	$442,609,000

b. Issues

Operating costs

c. Resolution of Issues

Requirements in Lease Section 16, together with the above condition, will make it mandatory on the lessee to provide reports on investment and operating costs at such times as the Mining Supervisor prescribes.

d. Recommendations

That section I-E-3 of the plan Modification be approved subject to the below condition.

e. Conditions

The lessee shall make available to the Mining Supervisor during the life of the project such data as he may reasonably require.

26. Part 14.0, Socio-Economics

a. Basic Plan

Over a 6-year period from 1977 to 1983, there will be a gradual increase in permanent site personnel to 1,600. After 1983, this number will remain constant. Peak total employment during construction of ancillary facilities will be about 1,180 and during the commercial phase construction about 2,900. In each of these periods, the buildup to peak employment occurs over a period of about 2 years and then drops off in about 1 year. Lessee submittal of April 18, 1977, provided a manpower skill breakdown for the commercial phase.

A two volume Socio-Economic Assessment Report was prepared by the lessees and submitted to and distributed by the Area Oil Shale Office in March, 1976. The report discusses mitigating procedures to socio-economic impacts which includes planning programs at the regional and local level and mitigation approaches by the lessees. The lessee's program includes provision of housing and services for workers and their families; community and region-wide assistance in securing housing and services to all C-b induced population; assistance at the local level with planning and facilitating government programs; and aid in carrying out programs to manage growth and to help maintain the quality of life in the area. Rio Blanco County has been provided $40,000 by the lessees for

planning purposes and the lessees are committed to cooperate and assist with local and regional entities in alleviating socio-economic impacts.

b. Issues

It is beyond the scope of the Mining Supervisor's authority to approve plan aspects related to socio-economics, except to enforce Lease Sections 18 through 21 pertaining to employment practices, equal opportunity, payment of taxes, and fair pricing of products produced from the leased deposit. The Mining Supervisor may also take necessary steps under Lease Section 32 and under the Lease Environmental Stipulations to insure that the tract and operations thereon do not destroy the short and long-term productivity and livelihood of the region.

The principal issues center about employee housing and boom type development of now small western Colorado communities.

c. Resolution of Issues

The lessee has aided in the formation of community impact mitigation task groups for the purpose of disseminating information on expected population growth, timing and funding assistance for planning and construction of needed services. Lessee has also offered guarantees of occupancy to builders and has committed about one million dollars of corporate funds for construction or rental of dwellings. A baseline

census for the region was funded by the U.S. Geological Survey. A portion of the bonus payments made by the lessee goes to a State fund to help defray costs for roads, schools, and other aspects within the impacted area.

27. Due Diligence

The lessee has submitted an original and modified Detailed Development Plan prior to the third anniversary date of the lease. The 2 year baseline monitoring program has been completed and the Final Baseline Data Report will be delivered shortly to the Area Oil Shale Office.

The schedule presented in the modified DDP shows production commencing in 1980 from an ancillary facility. This allows the lessee to meet the due diligence requirements of the lease. Calculations indicate that the actual production in the 6th lease year is about twice the minimum production required by the lease and that following years are significantly greater than the minimum production.

Order of magnitude cost estimates have been made to provide a general projection of the capital costs expected for the project. The following capital cost estimates show project costs through the time of plant construction; but exclude interest during construction, deferred capital expenditures, and escalation costs:

Mine	$136,696,000
Oil and gas processing	103,038,000
General Facilities	83,982,000
Other (engineering, home office, fees, working capital, contingency)	118,893,000
Total Capital Investment	$442,609,000

Lessee submittals of June 16 and June 28, 1977 address the subjects of retort stabilization and a post-operations abandonment plan. An investigation has been designed to determine the effect of abandoned retorts on ground water quality. Results of this investigation integrated with other background data will be used to design engineering criteria for the stabilization management employed. Permanent abandonment of the lease would involve removal of all buildings and structures, securing mine openings and underground workings, safeguarding all dams and ponds, removal of product storage tanks and pipelines, flushing and plugging of underground pipelines, reclamation of disturbed areas, and stabilization of retired retorts. Specific plans for decommissioning surface and underground facilities, conveying and material handling facilities, off-tract facilities, off-tract water diversion facilities, roads, dams, and the raw shale embankment are further presented in the submittals.

V. Recommendations

A. Rationale

A decision on the Modified Detailed Development Plan was arrived at only after careful consideration of the relevance of the proposed development scheme in relation to lease requirements for a diligent plan that would meet minimum royalty production in an environmentally conscious manner. Public and governmental comments were solicited on both the original DDP and the modification. In addition, the Oil Shale Environmental Advisory Panel consisting of representatives from concerned Federal, State, and local government agencies and private organizations, reviewed and advised the Mining Supervisor on the environmental aspects of both the original and modified plan.

The problems which resulted in a suspension of operations on September 1, 1976 have been resolved. The air quality control problem has been resolved by EPA through utilization of interpretive rulings, existing regulations, and policy statements that indicate if a facility is designed to meet all applicable State and Federal emmission regulations and incremental ambient standards, it may be constructed. The rock mechanics and resource recovery problem was resolved by the lessees decision to alter the scheme of development from conventional underground mining and surface retorting to modified in situ methods. In situ development will

increase overall resource recovery from approximately 300 million barrels to 1.2 billion barrels. Project life will also be increased from less than 20 years to 60 years, which will insure more stable economic and population growth for the region.

During the technical and public review of the modified plan, several areas warranting further technical clarification were identified. The lessee has provided needed supplemental date addressing these areas of concern, which is included by reference as part of the modified development plan. The issues identified in Part IV of this decision document have either been resolved by these responses or will be resolved by special conditions of approval.

It should also be noted that the tract area has been previously surveyed and cleared regarding significant historical and cultural values.

B. Recommendation

It is the opinion of this office that those portions of the original Detailed Development Plan (DDP), dated February 1976, the Modifications, and subsequent submissions constitute an acceptable and diligent Detailed Development Plan under Section 10(a) of the Lease, provided terms of the following conditions of approval are fully adhered to. These conditions constitute a synthesis of those recommended

in Section IV of this document. Approval grants the lessee the right to proceed with development of the leased oil shale deposits on Tract C-b by the modified in situ methods described in the modifications to the DDP in accordance with terms of the Lease, and with the environmental control plans set forth therein and in the Oil Shale Lease Environmental Stipulations. Development can commence at such time as the period of suspension is terminated and when terms of the conditions of approval are acknowledged, and those actions required prior to commencement of development have been achieved.

Granting approval will in no way waiver the obligation of the lessee to fully comply with all terms of the Lease and Environmental Stipulations, which shall be strictly enforced by this office under penalty of termination of operations, or with the requirement incumbent upon the lessee to obtain and comply with all applicable Federal, State, and local permits, laws, and regulations. All development and environmental control work on tract must proceed in accordance with the approved plan. Should it become necessary to further modify or change this plan, any such changes must first be approved in writing by the Mining Supervisor pursuant to Section 10 (b) of the Lease. With approval, notice will be given, that a complete copy of the approved plan and conditions are available for public inspection at the office

of the Area Oil Shale Mining Supervisor and at the administrative office of the lessee, on tract. In addition, reports covering all environmental baseline data; tract exploration; and forthcoming development, production, and environmental monitoring will also be available at the office of the Area Oil Shale Mining Supervisor for public inspection.

The Modified Development Plan will be considered approved as conditioned, upon the acceptance by the lessee of the following terms:

1. Prior to commencing any operations under the ancillary phase of the Detailed Development Plan (DDP), the lessee shall submit final design plans, as requested by the Mining Supervisor, for his review as to adherence to the DDP, to the terms of the Oil Shale Lease, and to the requirements of 30 CFR Part 231 and 43 CFR Part 23 or any subsequent applicable revisions thereof.
2. Prior to commencing construction of commercial phase facilities, the lessee shall submit plans, as requested by the Mining Supervisor, for his review and approval as to adherence to the plan of action contained in the DDP, to the terms of the Oil Shale Lease and to the requirements of 30 CFR Part 231 and 43 CFR Part 23 or any subsequent applicable revisions thereof.
3. In addition to the required annual report on environmental monitoring during and after the life of the project,

lessee shall make available to the Mining Supervisor environmental monitoring and other data at such time and in such format as he may reasonably require.

4. In recognition of the available options presented in the DDP, the lessee shall, prior to disposal of any potentially toxic wastes, including but not limited to, sewage sludge, garbage, mineral salts, and other industrial wastes, submit a final plan to the Mining Supervisor for approval. The disposal plan will emphasize reclamation or recycling where ever possible.

5. The lessee shall supplement the raw shale disposal plan and the erosion control and rehabilitation plan of the DDP by submitting a final description of the raw shale disposal sequence, grading and surface contouring to the Mining Supervisor for approval prior to surface disposal. The lessee shall continue to evaluate techniques for underground disposal of mined shale and/or feasibility of surface retorting. Specific details for disposal of solid or liquid wastes with raw shale shall also be included in the disposal scheme submitted.

6. Per lease environmental stipulation 1(c)(1), the environmental monitoring plan of October 1, 1976 shall be revised as needed, based on analysis of the final baseline data report. The revised plan shall be submitted for and approved by the Mining Supervisor prior to commencement of lateral mine development.

7. The lessee will incorporate the best practicable commercially available environmental control technology in all phases of the ancillary and commercial development. Environmental control plans shall be reviewed and revised as needed prior to implementation of the commercial phase development.

8. The plan for dams and impoundments contained in the DDP shall be supplemented by a water management plan that shall be submitted to the Mining Supervisor for approval prior to construction activities. The plan shall include a hydrologic monitoring program during shaft sinking, and a description of surface water handling facilities, dams, impoundments, seepage control, treatment facilities, and groundwater control in the vicinity of the in situ retorts during the ancillary and commercial phases of development. The plan will contain a contingency plan for excess flow. Impoundments and dams for storage of water of poor quality will be constructed and operated to prevent contamination of ground or surface waters. A copy of the required surface flow augmentation plan required under Colorado water laws shall be filed with the Area Oil Shale Office.

9. The lessee shall supplement the raw and retorted shale leaching study, outlined in the DDP, by initiating a program and submitting, prior to commercial phase

operations, a report on the mineralogy and leachability of raw and in situ processed shale on Tract C-b. The program will emphasize the solubility and mobility of trace and toxic constituents and the effects of leaching on the load bearing strength of the rubble filled retort chambers.

10. The abandonment plan contained in the DDP shall be supplemented to provide greater detail on retort retirement and stabilization based on the retort leaching study. The supplemented plan shall be submitted to the Mining Supervisor for approval prior to commercial phase retort development. The plan shall emphasize stabilization of in situ retorts, control of leaching from raw and processed shale, and reclamation practices for surface areas used for evaporation of waste waters if any.

11. The lessee shall maintain a program of continuing observation for items of historic, prehistoric, or scientific value during construction and tract operations. The reporting of uncovered objects shall be in compliance with Section 6 of the Oil Shale Lease Environmental Stipulations.

12. The lessee shall submit a detailed evaluation of the actual ancillary retort off gas composition on Tract C-b to the Mining Supervisor. Emission modeling and detailed air quality control plans, including stack

locations, for the commercial phase will be submitted by the lessee prior to implementation of the commercial phase development.